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THE

JOURNAL OF SCIENCE.

OCTOBER, 1883.

I. THE VELOCITY OF LIGHT.*

By O. REICHENBACH.

(Concluded from page 518.)

THE position of the centre of gravity of the earth, itself depending on the relation of mass of sea and earth, and so forth, determines the refraction of the elements constituting the atmosphere.

The index of refraction of water is 1·336; of sea-water, 1·343; when we modify the latter figure according to the mean temperature of the mass of the sea, 1·351. It is—

$$0{\cdot}351 : 1{\cdot}351 = 1 : 3{\cdot}83.$$

The light entering the sea experiences a loss of velocity, which is to the velocity of continuation as 1 : 2·83 as the densities of water to land, or inversely as their extents,—which means that the velocity of light in the average solid is zero; the light is entirely turned into other forms of gravity, which the reader may fully comprehend at the end of this article.

The mean amount of "terrestrian refraction," "the curvature of a nearly horizontal ray, taking the earth's curvature as unity, is between 1÷5 to 1÷6," and it is supposed and calculated that this curving is due to the decrease of density of the atmosphere with height:—

$$(1 \div 333) \div (1 \div 59{\cdot}56) = 1 \div 5{\cdot}56$$

* Referring frequently to "On some Properties of the Earth" (Wertheimer and Lea: London, 1880) I designate it by o. s. p.

terrestrian centrifugality drives the vapour with an additional $1 \div 5{\cdot}56$ against the air decreasing with height in density.

To fully appreciate the causal connection of all quantities I mention one ought to have read "On some Properties of the Earth." I quote from page 103:—"We get—

$$(11200' \times 29{\cdot}78) - 11200' \times (29{\cdot}78 \div 5{\cdot}7) = 275{,}108 \text{ feet}$$

as height of the atmosphere."

"But this is not the true height. We must account for the increase of centrifugality through the 275,108′. It is $1 \div 40$ (of the $1 \div 333$). This loss of gravity is diminished by the mass itself of the atmosphere between its limit and the earth, adding to the attraction of the latter. The whole loss so becomes—

$$1 \div 40 - (1 \div 333) = 1 \div 44{\cdot}63,$$

and the height of the atmosphere—

$$275{,}018' + (275{,}018' \div 44{\cdot}63) = 280{,}913', \text{ or } 6162' \text{ more.}"$$

The 6162′ are thus reduced $1 \div 29{\cdot}78$, to 5956″, &c.

And page 107:—"The height of the atmosphere is 278,172′, with the imaginary equivalent 281,065′." . . . . "If the outer atmosphere were composed like the inner one it would be—

$$(5956' \div 281{,}065')^2 = 1 \div 2186$$

of the mass of the atmosphere; as it is constituted we find it to be $1 \div 1655$. It is $1 \div 1655$, not $1 \div 1713$, because at its distance from the earth the attraction of the sun has increased and that of the earth decreased, so as to produce a difference of $1 \div (1713 \times 29{\cdot}78)$."*

Knowing, then, the height of the atmosphere and the velocity of light censed *in vacuo*, we know the time it takes for the light vibration to travel through that height, and we find the proportion:—As the height of the atmosphere is to the distance of the generator (or reflector) *in vacuo*, so is the time light requires in travelling through the atmosphere, as it is in the mean here below, to the time censed to be spent on the whole distance. When distance changes time changes.

* 278,172′ is about the figure of Bradley and Delambre. Certain modern astronomers suppose the height much greater. They seem not aware that their observations were made, and their reasons propounded and refuted, in the first quarter of this century.

The velocity of light with regard to the individual earth depends therefore on the quantities and qualities of the medium atmosphere, themselves subject to the interaction of earth and sun.

So little as light is heat, but both are intimately connected, so little are light and radiant heat identical: light therefore ends where we cease to see it in the spectrum; no thermometer, thermopile, or bolometer is made for it, but the eye is. Absence of light begins on the side of the red, where the uniform motion gets deviated, delayed, and divided by resistance, when the rotatory tendency of molecules exceeds that of vibratory propagation of transport or or orbital motion in the mass; darkness begins on the side of the violet, when the solar opposition and impulse against terrestrian and molecular centrifugality is so diminished by interposition in and deviation from its straight path, and the number of molecular vibrations so increased and the length of waves so reduced, that an altered polar action introduces new molecular combinations.

Any more or less diaphanous substance, or made diaphanous by change of state, being a distinct medium, produces a spectrum of its own, according to its gaseous, liquid, or solid state, the aggregational and the internal state of its molecules, and its changes in temperature, pressure, and form. Any such medium introduced into the atmosphere therefore modifies the atmospheric spectrum; but the atmosphere, air and water-stuff, is the true medium of light, the instrument formed by earth and sun for their use, and all other substances coming and going in it in small quantities are instruments that have to submit and fit in the atmospheric orchestra and its pitch, and to equalise and absorb their characteristics in the unity of harmony. The solar spectrum is the atmospheric spectrum, all kinds of molecules being there and here represented.

It follows from day and night, from the undulatory theory, that the scale of wave-lengths in this spectrum cannot surpass the scale $1 : 1 \div 2 = 2 : 1$, from darkness to darkness. Angström found the wave-lengths of line A 760·4 millionth of a millimetre, and of H_2 393·3, which gives for a metre for A 1,315,100, and for H_2 2,542,500 lengths.

"Not only the darkness of A and B, but their appearance depends on the relative position of the sun, on his being near the horizon"; "they are called entirely atmospheric." So it is with H_2; A will be more prominent in the morning, H_2 in the evening. "Janssen has even succeeded in producing, by absorption of vapour of water, black rays near

B and C and D," says Angström, who observed in high latitudes, during intense cold, that "certain telluric rays" disappeared, others became prominent (vapour rapidly absorbed by the sea o. s. p.). He found "A about 13 units broad,"—that is, 1·59·56 of its 760·4 (morning), and "many of Frauenhofer's rays are double rays."

H_2 and A are not the limits of darkness; the lengths of their waves are 393·3 : 760·4 = 1 : 1·9334, but the ratio of the limit lines identical with incipient darkness must be two. It is 2·000 − 1·9334 = 0·0667 and 0·0667 ÷ 2 = 1 ÷ 29·78, as all water-stuff of the mass of the atmosphere, and the change in solar distance, &c.

The wave-lengths must have a cause; there must exist a definite measure whose length represents a certain number of waves for white light as unity, and when broken up in all colours of the rainbow for these divisions. That measure can only be the mean height of the atmosphere.

The ascending and descending water-stuff, in mass to air 1 : 28·78, describes in the resisting medium between earth and atmosphere curves of every height, resting their branches on every basis up to a quadrant. The curves are parabolas having the sun for directrix, the vertex of the curve moving with the apparent position of the sun and the real position of the revolving earth and her strata. On the side of the earth towards the sun the attraction of sun and earth are opposed; the sun carries matter from the earth; on the other side the two masses join in bringing back lifted mass, the action of the sun being, however, weaker by greater distance.

The air developes in itself centrifugality, tending to increase its height: this action, being a pressure against the sun on the day-side is opposed by his centrifugality; the centrifugal portion of the air is forced to describe curves having their vertices towards the earth, the air becoming in itself divided in hyperbolas having their foci in the centres of sun and earth. On the night-side, when both attractions join, all the curves become parabolas,—water-stuff and the centrifugal 1 ÷ 44·63 of the air tending more to descend, and the general air, as representative of the mean centrifugality of the earth or sea, to ascend; warm air ascends when cold air and water-stuff descend. Where contention of sun and earth exceeds there is day, where coaction exceeds is night.*

* Meteors may become lighting outside the atmosphere, through increase of outside influences accelerating their translatory and rotary motion, and developing round them a liquidity and atmosphere of their own.

The opposing curves, representing contending forces, must, like all arrested motions, produce beside the actual transport of particles mass vibrations, conflicting contacts, waving of molecules wholly and in their own strata, characterising the particular molecules engaged.

The length of these waves being determined by the ratio of the contending forces, the diameters of the vibratory curves, the possible extent of their angular combination, or the relation of equatorial and mean centrifugality of the whole revolving mass and medium, which is by opposition continually in polar motion antagonistic to increase of centrifugality. The number of wave-lengths in direct white light not diverted and decomposed is therefore equal in the whole height of the atmosphere.

$$\frac{\text{Solar Distance} \times g \text{ at Surface of the Earth} \times \text{Pressure 1 of Atmosphere.} \times \text{Centrifugality at Equator to } g}{\text{Height of Atmosphere} \times G \div R^2 \text{ of Sun at that Surface} \times \text{Centrifugality developed in Atmosphere.} \times \text{Mean Centrifugality to } g.}$$

Or—

$$\frac{\text{Radius}}{\text{Cos } 30°}$$

Formula *b* :—

$$= 1{,}789{,}242 \times 1713 \times 44{\cdot}63 \times 333 \div 289 ; \text{ or } 1{\cdot}149 ;$$

which divided by 84,500 metres, the height of the atmosphere, gives to the metre 1,849,242 wave-lengths in the verse and transverse sense, and 540·7 mth. m.m. as length.

A and H_2 are not the limits of darkness; we get them on the side of the red by multiplying the 540·7 by $\sqrt{2}$ with 764·5 mth. m.m., and on that of the violet by dividing the 540·7 by $\sqrt{2}$ with 382·4 mth. m.m.; that is, respectively multiplying and dividing the 44·63 in formula *b* with $\sqrt{2}$.*

* Thinking that the last breaking-up line of white light, or the interference of the completely unequalised wave-lengths, representing the oscillating diameter through the vertex of the mean of all water-stuff curves mediating between actual transport and vibration of mass, must be a prominent line, I expected to find it in E, with 526·9 mth. m.m. wave-length or 1,897,000 waves to a metre, which itself, or whose immediate neighbourhood, divides the extent of the spectrum beginning from the side of the violet as 1 : 1·69, as the density of vapour to that of air, o. s. p. It does, however, not correspond to the wave-lengths of A and H_2 when the scale of 2 and the ascent and descent with $\sqrt{2}$ is maintained, and would, applied to formula *a*, increase solar distance, making the velocity of light 309,910,000 metres. The line is, however, not without particular interest.

Angström says "E has served me as a start in my micrometric measurements," without telling us why; "there are *really two* E's; it appears a dividing ray; but it is impossible in spectra of a high order to get a distinct and direct image of the double ray." He speaks of getting 1·4 units more

The correctness of the result obtained for the velocity of light by formula *a* depends on the correctness of the single terms, of which solar distance is the most uncertain.

I took $g = 9{\cdot}8088$ metre (Paris), a correction (not plain latitude) being trifling, for radius of the earth, 6,369,829 metres, or quadrant 10,000,000 metres. For height of the atmosphere $1 \div 75{\cdot}4$ of the radius, according to passage quoted from o. s. p., and for solar distance 23,730 radii, as appearing from the compressibility of the sea (see before), and from other reasons (mean motion in orbit 30071 metres in second), or—

$$23730 \times 75{\cdot}4 \times 84500\,m = 1789242 \times 84500\,m =$$
$$= 151{,}190{,}949{,}000 \text{ metres} = 94{,}900{,}000 \text{ miles},$$

about the *old* figure. Which brings the velocity of light through formula *a*, 305,686,029 metre a second, in complete agreement with the results of *b*.

Having long ago characterised electricity as resulting from a disturbance in the distribution of weight in certain strata of opposite hemispheres of mass and molecule, and since then shown in o. s. p. the part played with regard to our planet by a hemispheric inequality of $1 \div 29{\cdot}78$ of sea, atmosphere, and solid, answering to the inequality of solar distance, I pass on to Clerk Maxwell's hypothesis of the electro-magnetic nature of light.

He about says:—When V, the quantity expressing the velocity of propagation of electro-magnetic disturbance, is numerically equal to *v*, the number of electro-static units of electricity in the electro-magnetic unit, light is an electro-magnetic disturbance propagated in the same medium if V equal to the velocity of light. "Hence the agreement or disagreement of the values of V and *v* furnishes a test of the electro-magnetic theory of light." He then gives the following table:—

---

by grating 3 than by 2, and 1·4 units less by grating 2 than by 4, and sees no reason but a less appropriate construction of 3 and 4.

The difference between the 540·7 and 526·9 mth. m.m. is only 13·8 units. Angström speaks of a double ray, and allows for the coming and going a width of 13 units, and the wave-lengths of H_2 as found vary more than 3 units. When we deduct 1·4 unit from the 13·8, making them 12·4, they are the $1 \div 42{\cdot}6$ of the 526·9. There is undoubtedly much that is oscillatory about all quantities connected with light, as the quotients of $\frac{G}{R^2}$ into *g* vary, the outer atmosphere is a compressor, the atmosphere is not of equal height, and we have from bottom to top within the atmosphere between solar and terrestrian gravity the prominent relations $1 \div 1773$, $1 \div 1713$, $1 \div 1743$, $1 \div 1655$, &c.

Velocity of Light, metres per second.		Ratio of Electric Units.	
Fizeau ...	314,262,944	Weber ...	310,740,000
Aberration and Parallax .	308,000,000	Maxwell ...	288,000,000
Foucault ...	298,500,000	Thomsen .	282,000,000

To which the results of more recent experiments and determinations of parallax might be added: there is plenty of choice within certain limits.

Clerk Maxwell made the ohm $1 \div 28{\cdot}8$ of V, or, without being aware of it, as the mass of water-stuff is to that of air in the atmosphere, or the mass of salt to that of water in the sea.

The first determination of the ohm was confusing. "A body," "which in one second travels along a meridian from the pole to the equator, would have a velocity which on the electro-magnetic system is professedly represented by an ohm," the distance from pole to equator being "professedly" "10 million metres, or 10,000 kilometres." Maxwell said "professedly," "because velocity and distance may not be quite correct."

The meridian of Paris has been found to differ, the equator is no circle, and the shape of the earth and the distribution of gravity is not without farther complications; but any meridian from pole to equator has its companion, and they have their pair; the hemispheres are not of equal size; the greatest difference of two meridian semicircles is about 22,000 metres, and in the mean the circumference of the earth is about 40,000 kilometres.

Strange would it have been if a resistance which expressed as a velocity "professedly" represented the distance from equator to pole should be overcome in exactly a solar second, an arbitrary measure of time, sprung from the arbitrary division of a curve. For the division of the circle and the day are coeval; the not quite concordant divisions were a convenient and mystic compromise between the decimal system for the rigid mathematical figure and the more or less duo-decimal system in the motions of the most observed heavenly masses with regard to our earth.

The ohm is now determined 9413 kilometres, a velocity which would lead round the 40,000 kilometres in 4·248 secs. To the electric current moving from pole to equator and pole corresponds the magnet moving in transverse direction.

The mass of vapour continually lifted into the air by the sun is $1 \div 333 \times 1 \div 59{\cdot}56 = 1 \div 19833$ of the mass of the sea, containing $1 \div 29{\cdot}78$ of its weight in salt, led about by the

sun; these masses of conducting stuff, water in the air, salt in the sea, each in its comparative non-conductor, are moving wires round the earth, equally rich in iron, &c., o. s. p.

The earth turns round her axis in 23 hrs. 56′ 4·09″ = 86,164″; 86,164″ ÷ 19833 = 4·344″. As the mass of the conducted vapour lifted out of the salt sea into the dielectric air by the sun is to the mass of the conducting sea, so is the vibratory velocity of conduction round the earth through the atmosphere to one revolution of the conductor, the sea,—or rather the salt in the sea—round the earth with the earth.

4·344″ − 4·284″ = 0·096″ reduces the 9413 kilometres to 9202. It is 9413 − 9202 = 211, and 211 × 9413 = 1 ÷ 44·63, the centrifugal development through the whole of the atmosphere is a variation disregarded in calculations.

The lifted water, always representing with its descending branches the 1 ÷ 29·78 of the atmosphere, moves within the 28·78 times greater dielectric mass, and when we multiply the 9202 kilometres by 28·78, the very factor of Maxwell, we get for the electro-magnetic unit 264,833,560 metres, the process in the sea being the respondent, and the vibration through the earth the analogon.

When we multiply the 28·78 terrestrian mass resisting the 1 of mass appropriated by the sun by the surface of the earth, the magnet-stuff surrounded by the rings of water and air, we get, r being 1, $28{\cdot}78 \times 4\pi r^2 = 361{\cdot}649$ revolutions during one revolution round the guiding sun. When we divide the $4\pi r^2$ representing the resisting terrestrian surface by the percentage of mass actually transported by the sun in the resisting terrestrian mass, to the sum of both masses $4\pi r^2 \div (1 \div 29{\cdot}78)$, we get 374·215 revolutions. The actual number of revolutions being 365·25, the first result is 3·607 revolutions in default, the second 8·966 in excess.

The revolutions being constant during the year and equal amongst themselves, the retardations and accelerations must compensate each other, power against time, so as to maintain these twofold uniformities amidst the changes of solar distance, and under the influences of other bodies within and without the solar system acting directly and indirectly through the sun on the earth. The following are the chief ones of these differences embracing all others. It is retardation to acceleration,—

$$3{\cdot}607 : 8{\cdot}966 = 1 : 2{\cdot}49 = 2{\cdot}5,$$

as solar to lunar tidal action; the moon, more opposing than assisting solar tidal action, therefore maintains the equilibrium. That this lunar action is turned inductively

through the sun into electromagnetic action may be seen in o. s. p., where I speak of Allan Brown's observations in chapter "Terrestrian Magnetism."

3·607 is the 1÷101 of the year = (1÷6106)÷(1÷59·56). The divisor represents the ascending vapour in the air and salt in the sea, the vibration from the centre through the solid, the $\surd$ of the eccentricity of the earth, and the eccentricity of her orbit; the dividend the decrease in solar attraction through the diameter of the levelled solid of the earth, without sea, normal to the orbit. This quantity varying with solar distance, and ex- and inclusive of depth of sea and height of atmosphere, negative to terrestrian attraction on the dayside, and positive on the nightside, amounts for the whole sphere or neutrality to—

$$4\pi r^2 \div (1 \div 6106),$$

and for each hemisphere as negative or positive to—

$$2\pi r^2 \div (1 \div 6106).$$

The 8·959 revolutions are the 1÷40·76 of the year, the proportion of the own centrifugality of the atmosphere, exclusive of its diminution by the own mass of the atmosphere, and $40{\cdot}76^2 = 1655$; the 1÷1655 being o. s. p. the mass of the outer atmosphere to that of the atmosphere. The outer atmosphere is a compressor of essentially electro-magnetic nature, without vapour of water, induced by the polar action of the earth and the centrifugal and co-attractive action of the sun to special molecular combinations, determined in quantity by the difference of quotients of solar into terrestrian attraction at the top and bottom of the atmosphere and over sea and land, &c.

"It is manifest that the velocity of light and the ratio of the units are quantities of the same order of magnitude," but it is also evident that they are not identical.

The vibratory motion caused by the conducting vapour moving from equator to pole by alternate action of the sun and of the earth, as constituted in the course of time by that inter-action, is resisted by the centrifugal motion of an already determined portion of the air from pole to equator, which makes its motion vibratory, electric, the sea emitting and absorbing both vapour and air, the one preferentially in equatorial, the other in polar regions o. s. p. The resistance therefore is—

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Velocity of absolute centrifugality at the surface of the earth.

Equatorial centrifugality to g, the $1 \div 289{\cdot}5 + [(1 \div 24{\cdot}16) \div (1 \div 289{\cdot}5)\ (= 12{\cdot}08)] = = 1 \div 303$, one polar region being the $1 \div 24{\cdot}16$, both the $1 \div 12{\cdot}08$ of the sphere, &c.	$\times$ $1 \div 3{\cdot}83$, the polar arc to the quadrant or the surface of the land to that of the earth, &c., a comparative insulator in the sea, projecting as insulator into the atmosphere with a mean height, &c., o. s. p.

7933 metres $\times$ 303 $\times$ 3·83 = 9,202,000 metres, the ohm which, multiplied by the 28·78, gives $v = 264{,}813{,}560$ metres.

Heat is transformed into electricity and electricity into light, sunlight becomes heat and heat turns electricity. It remains to show why the 305,686,092 metres of the velocity of light are reduced to V.

The sun lifts the water-stuff from sea and land in a more elastic uniform outside stratum, and leads it in doubly alternating opposition and conjunction in a maintaining polar process, resisting to the tendency of absolute centrifugal dispersion, in the direction from equator to pole. The water-stuff, by its orbital and rotary motion resisted by the air, becomes the real distributor of light and heat, the equivalent of light and heat itself.

Electricity is a continual derangement and re-arrangement of a constitutional inequality in the hemispheric distribution of mass in masses and molecules. Vapour- and water-stuff generally are, by their constitutional qualities, neither prominent generators nor conductors of such derangement, but they are worse generators and better conductors than air; and so with salt, dissolved to brine, with regard to the water.

Moving through the air the vapour, not unassisted by other substances, produces that frictional and chemical derangement (the electric half) in the air, and conveys it, itself deranged by reaction, as other half, for re-arrangement back to sea and land, turned in form to ice, drops, vesicles, and electro-magnetic vapour.

The sea, with all its generating and conducting nerves penetrating through air and solid, is so shut up between the dielectric wrapper, air, itself housed in the outer atmosphere, and between a solid shell less conducting than the sea or inner earth. It acts as moving conductor wound round the nucleus saturated with iron. Each stratum thus has its own motion according to its molecular constitution.

When light and radiant heat, primarily as gravity two in one, are transformed in the air into electro-magnetism, it

therefore means that the vibratory motion has to lose in velocity of propagation or power, a proportion equal to the number of times the mass and substance, the vapour, the equivalent of light and radiant heat, has to be renewed, lifted, and thrown within a certain time by the limited amount of propelling solar force, struggling with terrestrian force.

I have shown in o. s. p. that the water-stuff in the air is annually renewed 7·78 times, its mass passing through the atmosphere representing $1 \div 29{\cdot}78 \times 7{\cdot}78 = 1 \div 3{\cdot}83$ of the mass of the latter, or the so manyth part as the polar arc to the quadrant, or the surface of land to that of the earth, &c.

It is $A - v = 305{,}686{,}029$ metre $- 264{,}813{,}560$ metre $=$ $= 40{,}872{,}469$ metre, which is not the $1 \div 7{\cdot}78$, but the $1 \div 7{\cdot}5$ of A. Assuming v more certain, A would have to be reduced by 1,814,421 metres to make the difference $1 \div 7{\cdot}78$ of A. Not believing the A obtained (or rather the solar distance introduced in formula *a*) so much at fault, my line of thought, represented in o. s. p. (where also see about the substances not water or air in the atmosphere), led me to see that $1 \div 7{\cdot}5 - 1 \div 7{\cdot}78 = 1 \div 170 = (1 \div 44{\cdot}63 \times 1 \div 3{\cdot}83)$, figures defined and here denoting that the height and centrifugal development of the air over sea and land are not identical.*

I mean to have proved that much of what is and what must be universal quality of matter depends quantitatively for the earth on the individual earth.

This fact and the variety in the most careful measurements suggest that the velocities A and V constant *in their mean* for the earth and year as united quantities, must be in inverse order variable amongst themselves according to solar distance and every division of place and time, and that any oscillation must become more apparent when short distances are the bases of measurement than when light is due to direct action from outside the earth. Such oscillation could not exceed—

$$1 \div 12{\cdot}08 - 1 \div 29{\cdot}78 + ((1 \div 12{\cdot}08 - 1 \div 29{\cdot}78) \times 1 \div 59{\cdot}56)) =$$
$$= 1 \div 20 \text{ of the maximum velocity.}$$

The two earliest, and at the same time most divergent,

* In o. s. p. and in the Journal of Science, "An Idea of Lord Bacon's," 1881, may be seen that there exist certain waves in sea and land, most discernible in the formation of the latter, starting from the south pole, propagated into the atmosphere, which present the relation $90° \div 7{\cdot}78 = 11°44'$, and that $3{\cdot}83 \times 2 = 7{\cdot}66 = \sqrt{59{\cdot}56}$, leads to waves 11°40', to a difference of 4', which transposed into time, 4·06', is to the day as the day is to the year, &c.

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experimental determinations, Fizeau's and Foucault's exceed only by 50,000 metres the proportion 20 to 19. My figure holding not quite the middle is, as it should be, somewhat nearer the minimum figure. Two or all three figures may not be quite correct, but it can be shown that the differences stand in a regular relation to the $\sqrt{1} \div 1655$, $\sqrt{1} \div 1713{\cdot}9$, $\sqrt{1} \div 1773$, &c.—that is, to the inverse squares of the quantities expressing the various leading relations of solar to terrestrian gravity at the surface of the earth and through the atmosphere.

II. THE DECEASED WIFE'S SISTER'S QUESTION: RATIONAL MARRIAGE-LAW.

IT may at first glance appear strange that we should here discuss a subject commonly regarded as falling mainly within the province of divines and jurists. We submit, however, that the entire question belongs solely and simply to the physiologist, and that as such it may with perfect right be considered in the "Journal of Science."

The first rudiments of a Marriage-Law—that is, the first restrictions on union between any two individuals of opposite sexes—have to be sought in the vegetable world. All those most interesting arrangements described by Darwin and others, tending to prevent self-fertilisation and ensure cross-fertilisation, are an unwritten but effective law for keeping apart those who are too near of kin. This law is self-executive: seeds which have been fecundated by the male element of a strange plant, or at least by that of another flower of the same plant,—which is substantially another individual,—germinate more freely, and give rise to more vigorous plants, than such as have been from any cause fecundated by the pollen of the flower which produced them.

If we pass to a consideration of the animal world we cannot fail to note a number of arrangements which tend to frustrate, or at least to render unlikely, sexual intercourse between kindred. Even among hermaphrodites, such as the slugs, self-impregnation is impossible, and the mutual

action of two individuals is required. Where the sexes are distinct, we find manifold provision to ensure the mating of males and females which are not respectively born of the same parents. Thus in the case of the solitary wasps and bees, though in some species the mother deposits her eggs in a single excavation in the trunk of a tree, or in a post, yet the larva which first reaches maturity flies away in search of a mate, as do the others in succession, and it is thus rendered exceedingly improbable that any two of them should meet again.

Since experiments have been made in India on the production of silk from certain so-called "wild" moths, of the genera *Bombyx*, *Attacus*, &c., it has been found that the males, on issuing from the cocoon, do not attempt to have intercourse with the young females, their sisters, but fly away. In their place stranger males arrive, and immediately set about copulation.

Another important agency to prevent in-breeding is that young animals, as they approach maturity, become less and less gregarious. Sometimes they separate spontaneously, and in other cases they are driven away by their parents, dispersion being thus effected.

Many kinds of caterpillars, even though up to that point they may have lived in large societies, all the descendants of one mother, yet when about to assume the pupa state set out on their travels, and often stray to a considerable distance from the plant upon which they feed. In many kinds of birds the two sexes seem during the winter to form distinct societies, and only seek each other up in the spring. In some migratory species the males and the females often arrive in separate flocks, at an interval of a few days—a habit which must render the pairing of brothers and sisters exceedingly unlikely.

These few instances, which might be greatly extended from facts already on record, and still more so from a special and closer study of the subject, prove that there exists a Marriage-Law throughout the organic world, the object of Nature being evidently that every female shall be fecundated, if at all, by a male of different blood. Consanguinity is the only bar recognised, and the one object to be avoided is degeneration.

From the lower animals we pass to man. Here it is proved beyond doubt that consanguineous marriages lead to a deteriorated offspring. Among the pernicious results deaf-mutism is one of the most common. Recent investigations show that in Berlin this affection is rare among adherents

of the Roman Catholic faith, much more common among Protestants, and exceedingly common among Jews. The question was naturally raised how the religious persuasion of a married couple could conceivably affect the liability of their offspring to deaf-mutism? The answer was not difficult to find: the Catholic church does not permit intermarriage between cousins, we believe even to the third degree. Among Protestants the same laxity prevails in Germany as there does in England, whilst among the Jews such marriages are not merely tolerated, but even encouraged, possibly for the sake of keeping the property of a family together. The result is the more serious as throughout Europe the Jews, from the obedience which they still render to the admirable sanitary laws of Moses, have in many respects a higher standard of health than their Gentile neighbours.

Assuming it, then, as a known fact that consanguineous marriages are racially injurious, we need not wonder that from a very remote age—probably from the pre-historical days—laws and customs prevailed for the prevention of such unions. The bewilderingly complex Marriage-Laws of many savage tribes (*e.g.*, of the Australian aborigines), whatever else they may effect or purpose, have at least the result of compelling every man to marry some woman not of his own kindred. The like must have been the consequence of marriage by capture, traces of which survive even among civilised communities. In man, then, as among his "poor relations," the objection to the intermarriage of any two individuals is the prospective probable deterioration of the race. In him this became a conviction founded on recorded experience and couched in words. Among the lower animals it was, where not dependent upon circumstances beyond the knowledge and control of the individual, what is commonly called an "instinct."

But in mankind, unfortunately, the principle early became adulterated. The rational limits which Nature places to marriage were relaxed in some directions and narrowed in others. The relaxation has consisted in permitting the intermarriage of cousins, which is now unfortunately sanctioned in all civilised communities except where the Catholic religion is acknowledged. This serious practical error was probably due either to covetousness—the desire to re-unite portions of an estate which had been divided among the sons of a former possessor—or to a pseudo-aristocratic sentiment. Thus the ancient Peruvian incas enfeebled themselves by constant intermarriage with blood relations, and thus, to

a minor degree, several of the royal and many of the noble families of Europe have married within a circle so narrow that degradation, bodily and mental, has been the result.

While on the one side injudicious and harmful relaxations of Nature's marriage-law have thus crept in, there have occurred on the other hand increased restrictions equally injudicious. Ecclesiastics and lawyers, not recognising the object to be kept in view, have added to the plain notion of consanguinity that of affinity, and even in the Middle Ages that of so-called "spiritual relationship."

The Catholic church, whilst wisely prohibiting the intermarriage of cousins, unwisely and needlessly forbade the union of persons connected merely by affinity,—*e.g.*, that of a man with the sister of his deceased wife. She even went a step further, and declared that a man and a woman who had both been sponsors at the baptism of the same child could not lawfully marry. What might be the motive for so strange a regulation, or what supposed evil it was intended to prevent, we are unable even to guess. But it appears that at one time a man might have no small difficulty in meeting with a woman whom he might legally marry unless he could either obtain a dispensation or seek for a wife in some remote part of the country. Hence much hardship arose, and doubts frequently arose as to the legitimacy of the descendants of certain marriages.

Still the Catholic church, if wrong, was at least consistent. She forbade marriage between relatives entirely, and if we grant that persons connected by affinity or "gossipry" *are* relatives, she is in the right; but this is the very point which we deny.

We Englishmen in this particular have held fast to our national character of inconsistency. We have prudently abolished spiritual relationship as an impediment to marriage, but we have retained affinity even whilst making serious inroads upon the fundamental principle of blood-relationship.

Hence when the "Marriage-Law Defence Union"—a body formed to oppose the Deceased Wife's Sister's Marriage Bill—say, in an advertisement, "The whole principle on which the Marriage-Law of this land is based is involved in the acceptance or rejection of the Deceased Wife's Sister's Bill," they venture on a very wild statement. The Marriage-Law of this land is based on no principle. It is a medley of enactments arbitrarily thrown together, and having no vital connection. It tolerates what it should forbid, and it forbids what it should tolerate. If we analyse the table of

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prohibited degrees, as appended to the Prayer-Book, we find grades of consanguinity and affinity not shown separately, but mixed together as though of equal significance. Nay, whilst ten degrees of consanguinity only are specified as constituting a bar to marriage, the degrees of affinity excluded are twice ten, as if to show that, in the opinion of the framers of this table, affinity constitutes a more important impediment than consanguinity!

The advertisement above quoted continues:—"In all countries where the Marriage-Law has been relaxed in this one particular, other relaxations have, after some lapse of time, been adopted; in some countries not only may a woman marry her [deceased] sister's husband, and a man marry his [deceased] brother's wife and [or] his wife's niece, or, as in the State of New York, his wife's daughter, but in others a man is freely permitted to marry his niece by blood."

The writers of the lines just quoted evidently fail to recognise the difference, *toto cælo*, which exists between consanguinity and affinity, or they would never speak of marriage with a niece by blood being a relaxation likely to spring from sanctioning marriage with a deceased wife's sister. If, like ourselves, they would protest against the intermarriage of uncle and niece, they should remember that this is merely an extension of the "relaxation" which already exists in England,—the permission for the intermarriage of cousins. The advocates of the Deceased Wife's Sister's Bill are more or less consciously moving in a direction which will give the English Marriage-Law a definite principle. Not a few of them, whilst seeking to expunge all prohibitions based upon mere affinity, aim at securing for the law a definite physiological basis by forbidding the marriages of cousins. They aim not at laxity, but at a rational consistent strictness.

Of this we may be sure, that if marriage with a deceased wife's sister be wrong, it can be wrong only in virtue of evil consequences, just as drunkenness is wrong because it ruins the health of the drunkard and of his descendants. Let, then, the "Marriage-Law Defence Union" bring forward, if they can, facts, vital statistics. Let them show, if they can, that the issue of such marriages is more liable to deaf-mutism, blindness, idiocy, insanity, consumption, scrofula, &c., or that they have a greater tendency to crime than the average of their neighbours, countrymen, or contemporaries. Let them supply such evidence as this, and no one would be more eager for the maintenance of the existing law in this respect than ourselves. But in this direction, let it be noted,

they have made not the slightest effort: none of the speeches made in Parliament or elsewhere against the Deceased Wife's Sister's Bill, none of the advertised publications of the Marriage-Law Defence Union," seek to show that such marriages have had, or are even likely to have, any effects hurtful to the individual or to the race. The list of patrons, vice-presidents, and committee-men which they publish contains the names of many persons of consideration,—prelates, peers, judges, members of parliament, military and naval officers, but not medical or physiological authorities. This seems to us a token that the Union ignore the only kind of argument which we can accept. The publications or tracts which they advertise, and which from their prices are evidently intended for distribution, contain in like manner the opinions of eminent lawyers, statesmen, and ecclesiastics,—a class of evidence which we must set aside as totally irrelevant. "What the Bishop of London says," "what Scotchmen say," "what the Roman Catholic Church says," &c., is all beside the question, and can merely serve to divert public attention into a wrong channel. Those indeed who, tacitly at least, sanction the intermarriage of cousins, demonstrably injurious, and yet hesitate about or oppose the Deceased Wife's Sisters Bill, are indeed straining at the gnat after swallowing the camel.

A rational table of "prohibited degrees," based upon the results of modern Science, might be drawn up in very brief compass. It would simply enact that no intermarriage might take place between descendants of the same father, mother, or both, between descendants of the same grandfather, grandmother, or both, and between descendants of the same great-grandfather, great-grandmother, or of both. This would bar all unions between blood-relations as far as second cousins inclusive, whilst all cases of mere affinity would be excluded from its operation.

Still this table would not complete the Marriage-Law of the Future. It must, in addition, contain stipulations against marriages being contracted not merely when the parties are *below*, but also *above*, a certain age,—a point upon which the laws of all nations have hitherto been silent, but which, if Mr. Francis Galton's art of "eugenics" is ever to become a reality, will also have to be taken into consideration in mankind as it is in the more valuable domestic animals.

Those in whom chronic disease or insanity is manifest will likewise be recognised as unfit for marriage.

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By dint of such regulations, to which the world will ultimately be driven, the race will be ennobled, and there will be no weaklings produced to be trodden down in the "struggle for existence."

III. ON SANITARY REFORM.

By Rev. S. Barber.

WHETHER the present system of appointing Medical Officers to Public Boards is the only practicable one, or not, we need not now discuss, but I will merely remark that it would not be easy to conceive of a worse, the evils that attach themselves to it being unmistakable—"gross as a mountain, open, palpable." Two cases are in my mind as I write: one, that of a medical man who has, for some extraordinary crotchet, systematically opposed the efforts of the more intelligent inhabitants of the town to procure the sewering of a place of nearly 10,000 population (still unsewered); the other, that of an officer of a Local Board who is a notorious drunkard, and shamefully ill-treats his own child. It may possibly be said that such cases are quite exceptional, and that every effort is made to ensure satisfactory appointments. However this may be, to pass to another point, it can hardly be disputed that the selecting for Officer of Public Health one who has a personal interest in the continuance of disease is not a rational selection. We may ask, How is the income of a medical man to be estimated except by reference to his receipts,—in other words, the *cases of sickness* upon his books? And if any diminution of the number of such cases represents a diminution of the capitalised value of his medical goodwill, such decrease means so much pecuniary loss to the doctor.

Clearly, then, it is at once irrational and adverse to the interests of the public to appoint, as Medical Officer to a Public Board, a physician in practice in the district presided over by such Board; for if in his *public* position he has proved himself energetic and successful in the improvement

of public health and the reduction of disease, he has extracted by his philanthropy so much money from his own pocket. It is evident, indeed, that there are to be found noble examples of integrity and self-sacrifice in the medical profession; but, on the other hand, it is to be feared that these are qualities which do not always commend themselves to local Trustees, or enhance the claims of candidates for their appointments. But whether this be the case or not, it cannot be said to be just to the inhabitants of a district that their sanitary condition should be dependent on the very slender chance of these qualities operating *pro bono publico* in any individual. We require not only that such positions should be given to men whose character and attainments are above suspicion, but that either some system of better checking from the Central Authority be devised, or that these positions be held for shorter periods, to prevent the development of that spirit of autocracy and local wire-pulling which become here, as in other departments of social organisation, the destruction of progress and philanthropic exertion. The present system seems to hang too much on a single thread. The matter of public health is of too great moment to be so treated; and those ratepayers who desire improvement deserve consideration equally with the mere cheese-paring economists, whose fancied frugality proves too often the greatest extravagance. That economy is required in those who manage public concerns is unquestionable; but the true, intelligent economy, which alone deserves the name, is rather the management of force and the wise application of it, than the reduction of appliances and the mere negation of expenditure.

This is a question for ratepayers to consider. Let them not forget that what is worth doing is worth doing well. Both the people and the press are bound to do their part in arousing and encouraging those to whom management of sanitary matters has been committed. The work is one which eminently demands united action; and it is certain that sluggishness and apathy are the blameworthy causes of untold disease, vice, and moral degradation. Contrasted with the work of these subtle yet potent factors of social misery, the ruin effected on the battle-field sinks into complete insignificance.

It would be an extravagant allowance to take an average of 5000 men per annum as the slaughter of Englishmen in battle; but, according to Dr. Maclagan,* 20,000 is about

* See article in Nineteenth Century, November, 1879—"Is Typhoid Feve Contagious?"

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the number yearly sacrificed to typhoid. In spite of popular lectures on chemistry few persons are fully aware of the effect that free oxygenation has on the human frame. And if any true idea of the necessity of pure air to health could be insensed into the millions of our people, prodigious indeed would be the reduction of the annual bills of mortality.

IV. MEMORANDA OF FLOOD AND STORM IN THE YEAR 1883.

By A. H. Swinton.

THE outcry and grumble concerning our damp soggy winter and harvest prospects had hardly subsided when some interested parties at the sea-side got up an excitement by the prediction of a high tide. Many doubtless imagined men of Science had made some new discovery, and took tickets to Ramsgate or Jersey, places they would not otherwise have visited, in order to verify the important revelation. It is doubtful, however, if a greater amount of learning than any harbour-master has at his finger's ends was ever expended on the matter. Ages have passed since Seneca noticed that the flux and reflux in the tideless Mediterranean is greatest at the equinoctial; and only a year or two ago we were assured that at the time of the Equinox, and in stormy winter seasons, there is a much greater rise and fall in the water of our own Humber than would otherwise occur. It is consequently, then, not essential to puzzle over a malevolent conjunction of the Moon and Saturn in order to predict a high tide; nor is it essential to have deep insight into lunar and solar semi-diurnals and diurnals, and the excentricity of the orbits causing inequalities as the discord of harmonic notes. Indeed nothing now-a-days further than Whitaker's Almanack is essential to make a man a prophet of the long-shore tides. In that useful compendium we glean that the direction of strong winds, as well as the varying pressure of the atmosphere, considerably affects both the times and the heights of high

water. As every sun-burnt yachtsman who has luffed and gyved for the purse of guineas knows, in the North Sea a strong nor'-nor'-wester, and a low barometer, raises the surface 2 or 3 feet, and causes the tide to set all along the coast from the Pentland Frith to London half an hour longer than is usual; while south-easterly and south-westerly winds produce opposite effects, which are felt as far down Channel as Dungeness. Again, in the Chops of the Channel, at Plymouth, and as far up as Portland, a sou'-wester with a low barometer raises the surface of the water, and north-easterly winds and a high barometer always lower it.

Now last March it so came about that the new moon fell on the afternoon of the 7th; and this auspicious event, on the same authority, would produce high tides between the 9th and 14th of the month. That these equinoctial tides would be extraordinary anyone might have assumed when a storm-warning arrived from New York, to the effect that "A disturbance likely to develop dangerous energy is crossing north of latitude 40°, and will arrive on the North British and Norwegian coasts between the 3rd and 5th proximo, attended by south veering to west gales"; with the supplementary remark, "Another follows two days after, and will affect Norway. Atlantic very stormy." At the time the barometer was already on the drop, and from the 5th until the 12th the mercury subsided; and then the aërial whirlpool was spinning eastward of the North Sea, and northerly winds blew strong on the eastern coasts of our island, accompanied with driving snow, rain, and sleet. Beneath the suction of moon, wind, and atmospheric vacuum, the tide began to mount like water in a pump. From the Pentland Frith to the Thames it rose, rolling in like a Noachian deluge. At the time of high water at London Bridge the tide had risen more than 2½ feet beyond the Trinity stone; and it ran up, spectators say, with great force for another twenty minutes, when it stood 3 feet above Trinity level and swamped the Surrey pier. At Dover the water surged to within a few inches of the top of the quays, and only the chopping of the wind to the north-west saved the town an inundation. The tide in the River Tees was one of the highest within recollection, and at Hull the salt spray drenched a fashionable congregation in St. Mary's Church and floated a low-lying district. The prodigies of the remarkable tide were supplemented in the newspapers by an account of a tidal wave in the Channel, one calm night, that might shame the bore of the Hooghly or Severn; but I am afraid the adventure that befell the *Aquila* steam-

packet, bound for Jersey, on that memorable occasion, must be consigned to the limbo of the great sea-serpent seen at Oban and the phantom ship of the Lagoons. Nor does it seem probable that this could have been an earthquake wave, or that any earthquake occurred about the 30th of March.

There appears no reason why the statistics of tide-guages should not appertain to the department of Solar Physics as much as the statistics of river-metres do; but I do not know any authority on the subject. Gewitter and Zündende Blitze, however, distinctly fall into Dr. Hahn's prolegomena, and storms and terrible lightnings we have of late experienced with a vengeance. Indeed the transit from June to July has been as wholly made over to the suzerainty of summer lightnings as the identical Romeo and Juliet period in 1878 was. Immersed in the exhaustive sultriness of an Italian solstice, our eyes have grown blear in watching the fantastic shapes of the mountainous clouds ever looming like ghouls of destruction on the horizon, menacing us from every quarter, and stretching out unawares their leaden wings over the expanse of summer blue. Incessantly a lurid light with hideous glare has vexed the repose and sparkle of the landscape. Electricians say that there is most free electricity in the air about sunrise and sundown, and least at noon; but we have experienced a day discharge and a night discharge, and the nerves of our ears are in unison with the patter of hail and the roar of the mill-race down the gutter. Several churches have been damaged by lightning, one being St. Botolph's at Cambridge, and many individuals have perished through an imprudence in sheltering beneath trees; houses in certain streets have been fired, leaving us to accuse the telegraph-wires, or quite as likely bad ventilation, judging from the propensity Old Nick has for coming down the chimney; and in one case the rifle of a sentry on duty has proved a fatal conductor of the electric fluid. Barns and stores have been fired, and a holocaust of cattle destroyed. Had no worse calamities befallen us as a nation, the tale of disaster would be dire even divested of the imaginary.

On the afternoon of June 21st, when the thermometer stood at no great height, a thunderstorm passed over Guildford. On the 24th a slight earthquake was experienced in Cornwall—a more serious affair than a slight trembling I felt at Maida Hill a few years ago, as would appear. During the night of the same day Cambridgeshire—a name suggestive of vaporous exhalations—became the centre of electrical disturbance; and the next day the lightning passed

in the wind's eye, and played freely along a line drawn across England from the Thames to the Dee. The next day Cambridgeshire was still the centre of electrical disturbance, which moved southwards, the wind being west. From June 28th until July 4th the thermometer rose high in London, reaching as much as 84 degrees in the shade, and on Friday, June 29th, the heat at Aldershot was so excessive that the manœuvres had to be postponed. About midnight there were thunderstorms in the south-eastern counties. On Saturday evening the electrical disturbance was pavilioned near the Wash in Lincolnshire and Norfolk, while the south-east was bathed in a prolonged and peaceful twilight. On Sunday, July 1st, the thunderstorms danced away to the east of Scotland and the vicinity of the Forth. On Monday evening the electrical disturbance had shifted to Jersey, and some wished it fairly on the road to Spain. But as I looked from my window, towards midnight, there it was back like a Will-o'-the-wisp, bilious, growling, and flashing. The wind was reported to have been from the south-west at the time, but the electrical discharge ran right up the centre of England from Hampshire to Yorkshire. The next day the disturbance centred in Yorkshire and spread to France, and about this time to Switzerland, destroying man and cattle in the pastures. Then the temperature at York reached 70 degrees. About midnight it is related that there was a thunderstorm at Chatham, where a policeman was killed; but on Wednesday afternoon the chief disturbance was on the north-west coast at Ardrossan, whence it ran south to Chester.

In a late communication I drew attention to the waves of heat and cold that make up what is termed climate, and I believe it may be shown by statistics that a great heat-wave has just passed over our heads, travelling from west to east, of which heat-wave the earthquake was the herald. The lightnings and thunders in this sense might be compared to the discharge of a thermo-electric machine, the flashes moving to the point where the air temperature stood highest, as appears in many cases. The path of the discharges that branded our island with the sign of the cross, from east to west and south to north, further substantiates this view; and it may be observed that the whole disturbed area is pretty well included by the July isotherm of 59 degrees, in which we may consider London, Cambridge, York, &c., as so many warm centres, the carbons of the recent discharges.

It appears to be pretty generally admitted that Auroræ Boreales and magnetic storms arise from the sun-spots when

they are of unusual magnitude and centred upon our globe; but can sun-spots originate a heat-wave with thunder-storms? To comprehend this question, while the recent electrical commotions were in progress, I one evening turned a field telescope upon the sun when on the point of setting, and there plain enough were the spots near the centre of the disk,—one large and triangular, with a distinctly distinguishable umbra: someone, I understand, has calculated that they have been occupying 50,000 square miles of the sun's surface. If, therefore, spectroscopists do not allow the nucleus of the sun to be black hot, peradventure it has been reflecting the heat of its photosphere like a cannon-ball through its rags and tatters.

The rose, it is said, was disclosed from the brain of the thunder god, so flood and storm may leave a trace of the beautiful behind. Since I first saw the banks of the Wey the golden day-star has run from a period of few spots to a period of many spots, and Nature has run through a cycle of change. In 1875 grasshoppers sang merrily over the grassy slopes in the autumn; lately it would be hard to find them nearer than Box Hill, where, last year and this, they have been in some plenty. The painted lady butterfly was common here for a series of years; the last two years there have been none to be seen, and now this spring a few have come back. The clouded yellow butterfly, of which only one example came under my notice in 1875 and 1881, was great game for schoolboys in 1877; and in 1881 the whole country was a-flame with common yellow underwing moths. The last two years the silver writing of slug and snail has covered leaf and garden-seat. I remember a similar visitation in the Highlands during the wet in the early portion of the summer of 1868. This year the bookworm has taken the place of cricket and cockroach, and multiplied in the chinks of our kitchen hearth,—an evil prognostication for literature,—and I have noticed the cow parsnip in the hedge-row in luxuriant, and I think unusual, blossom.

V. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 551.)

IN this article we shall place before our readers the number of Science Schools, the number of pupils attending these schools, their successes, and the cost to the country of the science instruction carried out under the Department of Science and Art in these Institutions. I think the facts that will presently be stated on these branches of the subject, taken in conjunction with those stated in previous articles, will be sufficient to convince all independent thinkers on the subject of Scientific and Technical education that the system is most inefficient and costly. A scheme less costly and more efficient will be proposed in the next article, prefaced by showing what could be accomplished even in evening Science Schools, by stating what has actually been accomplished in evening Science Classes.

In the last article it was pointed out that the Department held Science Examinations in two different classes of educational institutions, *viz.*, Training Colleges and the so-called Science Schools. The number of Training Colleges in England, Wales, and Scotland, in which the Department held Science Examinations in December, 1881, amounted to 37, distributed as follows:—

England and Wales.

For Masters only	17
For Mistresses only	15
For both Masters and Mistresses	1

Scotland.

For both Masters and Mistresses	4
Total	37

It is not recorded in their Report, as far as I can make out, the number of individuals under instruction in these colleges; all that is given in the Report are the number of

classes examined (which amounted in December, 1881, to 105) and the number of successful individuals (these numbered 1521); with a larger number of classes than in the previous year a fewer number were successful, and in all the subjects examined upon the successes were the most numerous in the lowest stage, and in the second (the lowest) class in that stage; in Elementary Botany, for example, 30 passed in the first class, 297 in the second class, and 170 failed; and the opinions of the Department's own Examiners on the Science teaching given in these Colleges were quoted in the last article (p. 542).

For this worse than doubtful Science teaching there was paid to the teachers in the English and Welsh Colleges £3308 3*s.* 4*d.*, and to those in the Scotch Colleges £403 3*s.* 4*d.*, making a total of £3711 6*s.* 8*d.*

Before proceeding with the investigation into the so-called Science Schools, we will give a quotation from the twenty-ninth Report respecting them, which will show the *ricketty* foundation on which, according to the opinion of the Department itself, very nearly two-thirds of these schools are based, although a most expensive administrative machinery for governing and directing these ephemeral institutions has been permanently established on a very substantial money basis. It is stated in the Report "that the term 'Science School' is employed in this Report in a somewhat wide sense, each separate institution in which *one branch* of Science, or more than one, is taught, in connection with the Department of Science and Art, being counted as a School." Examinations were conducted in the sessional year 1880-81 in 1360 of these Science Schools; of these 1000 were in England and Wales, 151 in Scotland, and 209 in Ireland; and, according to the Report, out of this number there are about 260 of these of a more or less *ephemeral* character," and there are about 580 of them "which *depend* more on the teacher or the teachers, *through whose energy* they came into operation, than on any very *permanent local organisation.* They are superintended by Committees, but they are generally held in rooms hired for the purpose, and *though they have been in operation for some years*, and it is *probable* that they will be continued, *the death or removal of the teacher might, and in many cases would, lead to their being closed.*"

The number of individuals under instruction amounted to 61,177: whether in this number are included those under instruction in the Training Colleges does not appear to be stated in the Report. Before stating the number who came

up for examination, it is desirable to impress again upon the reader that the teacher is only paid for instructing those who *pass;* he is not paid by the STATE anything whatever for those who do not come up for examination, or for those who do not pass, and therefore I think everyone will agree with me that the Department has no right—as we shall see further on they do—to take *credit for those they do not pay the teacher for instructing;* they do this apparently for the sake of making the expenditure appear less than it really is, by counting those they do not pay the teacher for instructing as well as those they do pay for.

The number who came up for examination amounted to 38,837; in addition 5804 self-taught students, and pupils in classes *not entitled to claim payment on results*, presented themselves for examination: out of the total 44,641 individuals who presented themselves, 30,518 passed. The Report gives no information, as far as I can discover, as to how many of the 5804 passed on whom payment on results could not be claimed.

We have arrived, then, at the number of individuals under instruction, the number who came up for examination, and the number who passed; and now what we would desire to know is *how they passed*, but on this essential point for testing the efficiency and benefits of the instruction the Report fails in giving the necessary information; it is vague and mysterious on this most important point. We are told, in the table on page 55 of the Report, that "the number who came up in the Elementary Stage alone amounted to 57,614, and yet we had been previously informed that only 44,641 presented themselves in all the different stages. We have to go back to page 53 of the Report to find out what the Department *means* by the number who came up; it means "the total number of papers worked." It was new to me to learn, as I think it will be to all my readers, that a *paper* can can come up for examination, and can pass or fail. As there are twenty-four subjects examined upon, and as a student may, and very frequently does, go in for more than one subject, the number of papers worked gives no information as to the number of students who came up in the different stages, and their successes; however, I can only give it as I find it in the Report: the reader has consequently to remember that the expression "the number who came up" in the different stages means the number of papers worked, and not the number of individual students;—

Number who came up in the *Elementary Stage*	57,614
„ of First-class Successes	10,976
„ of Second-class Successes	27,799
„ of Failures...	18,839
Number who came up in the *Advanced Stage*	13,344
„ of First-class Successes	2,200
„ of Second-class Successes	7,137
„ of Failures...	4,007
Number who came up in *Honours*	1,342
„ of First-class Successes	91
„ of Second-class Successes	395
„ of Failures...	856

This table reveals to some extent the state of Science teaching in the United Kingdom, under the Department of Science and Art, in the sessional year 1880-81, and it presents no flattering picture of the value of the teaching given in these Science Schools; and this is due mainly, if not entirely, to the system of teaching that has to be pursued, and the *miserable pittance*, as will be shown presently, many of the teachers receive for their labours. Sixty-three per cent only came up for examination, and deducting 4000 from the 30,518 as representing the number who passed out of the 5804 self-taught students, &c., only 43·34 per cent passed, and the majority passed in the elementary stage, and chiefly in the second or lowest class. Only 91 successful papers were worked in the first class in the Honours; and if we take the successful students in this class as working on an average two papers each, we find that out of the whole number of students only 45 passed in the first class in the highest stage, and probably these successful ones chiefly belonged to the class of self-taught students, &c., on whom no payment was made. It may be replied that only a very small number of the students at the different Colleges at Cambridge, Oxford, Dublin, &c., succeed in passing the examinations for the highest prizes, but there is no parallel between the two cases; the students at the Colleges ascertain, by reason of their intermixing together, who are most likely to be successful in these examinations; this knowledge operates, therefore, in limiting the number who compete; but there is no intermixture of the students in the 1360 Science Schools: furthermore, these schools are scattered over the United Kingdom, while the colleges are restricted to a small area of the country.

Before passing to the question of payment, we will give the number who come up for examination in Chemistry; as in the individual subjects the number must, I think, represent those who came up, passed, or failed, as well as the number of papers worked. The number who came up in Inorganic Chemistry (Theoretical) amounted to 5299 for the Elementary Stage and 938 for the Advanced Stage; or for every 100 who presented themselves for examination in the Elementary Stage, 17·7 presented themselves in the Advanced Stage. No entry appears in the Report for the Honours Stage; indeed the Honours Examination for all the twenty-four subjects examined upon appears, as far as the Science Schools are concerned, to be more for ornament than for use. The following are the numbers who passed and failed in the different branches of Chemistry (Theoretical and Practical):—

Elementary Stage, Inorganic Chemistry (Theoretical).

		Percentage Numbers.
Number of First-class Successes...	1226	23·13
,, of Second-class Successes	2604	49·14
,, of Failures	1469	27·72

Advanced Stage.

Number of First-class Successes...	115	12·26
,, of Second-class Successes	523	55·75
,, of Failures	300	31·98

Inorganic Chemistry (Practical), Elementary Stage.

		Percentage Numbers.
Number of First-class Successes...	682	39·95
,, of Second-class Successes	774	45·34
,, of Failures	251	14·70

Advanced Stage.

Number of First-class Successes...	208	29·17
,, of Second-class Successes	263	36·88
,, of Failures	242	33·94

XUM

Organic Chemistry (Theoretical), Elementary Stage.

		Percentage Numbers.
Number of First-class Successes...	55	31·42
„ of Second-class Successes	71	40·57
„ of Failures	49	28·00

Advanced Stage.

Number of First-class Successes...	22	29·33
„ of Second-class Successes	37	49·33
„ of Failures	16	21·33

Organic Chemistry (Practical), Elementary Stage.

		Percentage Numbers.
Number of First-class Successes...	22	26·50
„ of Second-class Successes	38	45·78
„ of Failures	23	27·71

Advanced Stage.

Number of First-class Successes...	54	54·00
„ of Second-class Successes	29	29·00
„ of Failures	17	17·00

In perusing these figures we notice that whilst 5299 went in for examination in the Elementary and 938 in the Advanced Stage in Inorganic Chemistry, only 175 went in for examination in the Elementary and 75 in the Advanced Stage in Organic Chemistry: this appears but a small return from the 1360 schools, or the 61,177 pupils in these schools, supplemented as this number was by 5804 pupils from extraneous sources.

We are deprived of the means of forming any opinion on the practical examinations in the Advanced Stage, both in Inorganic and Organic Chemistry, for, unlike the examinations given in every other subject, even in every other examination in Chemistry, including the Elementary Practical in both divisions of the Science, the examination given is not stated; all that the public are informed about these examinations is, that a certain number of substances may or may not be present in the mixtures given for analysis; we are not informed how many and what substances were present. No good and sufficient reason can be assigned for withholding this information from the public; for if the

substances given were stated it would not assist the teacher in cramming up his pupils for these analytical examinations in the future,—yet this information is withheld, whilst the questions given in the theoretical examinations are printed, which information materially assists the teacher in cramming up his pupils for these examinations hereafter, especially as there is always the same set of examiners.

I believe, from the experience I have had in this class of examinations, that if 75 per cent of the substances that it is stated may be contained in the *mixtures* were present, and the students had to examine for all the substances named, not many of them would be able to complete the analytical examination with tolerable accuracy *in the time allowed*, viz., four hours; and their difficulties would be further increased if they were unfamiliar with the laboratory they were examined in, as must frequently be the case, and especially as no competent person may be present to direct them.

What are termed the elementary practical examinations in Chemistry I regard as no more practical than what are termed the theoretical examinations, as they are merely written examinations like the latter; indeed the Department does not appear to attach much importance to them, as they give the teacher 10*s.* less for a first class in these elementary examinations than for a first class in the elementary theoretical division, although, according to the Deparment's rules, each lesson in the practical course must last at least an hour and a half, whilst in the elementary theoretical it need only last one hour.

We have now arrived at that stage of the investigation when we must examine into the cost of these Science Schools. In the financial year 1880-81 the payment on results to the teachers in the 1000 schools in England and Wales amounted to £32,723 4*s.* 4*d.*; the teachers in the 151 schools in Scotland were paid £5803 7*s.* 5*d.*, and those in the 209 schools in Ireland £4992 11*s.*; making a total of £43,519 2*s.* 9*d.*: there was therefore paid to the Science teachers in the Training Colleges and Schools in that year £47,230 9*s.* 5*d.*

The £43,519 2*s.* 9*d.* had to be distributed amongst 1762 teachers: the average payment per teacher was therefore £24 13*s.* 11*d.*,—not a large sum when we consider what the country expects them to accomplish; but in probing a little deeper into these statistics we arrive at results which will astonish most people. It will be found, on examination, that in more than one-third—*viz.*, 369—of the schools in

England and Wales the payments of the teachers varied from £1 to £10, and in 21 of the schools the former sum only was obtained; in 66 out of the 209 schools in Ireland the teachers' payment varied from £1 to £10; and in 46 out of the 151 schools in Scotland the teachers' payment varied from £2 to £10. It will be observed that the payment to the Science teachers in Scotland never descended to the munificent sum of £1. When the payment exceeded £1, but did not exceed £10, the miserable pittance had to be shared not unfrequently by two or more teachers; I noticed in one case that *four* teachers had to share £7 between them. Let us notice next the *time* a teacher must give, even *to have a chance* of obtaining a result payment of £1; he must, even to have a chance of gaining that small sum, give—at least so states the "Science Directory"—28 lessons, and each lesson must last at least one hour for the theoretical courses and one hour and a half for the practical courses. "It is not meant"—so states the "Directory"—"*in any way to suggest that that amount of instruction is sufficient,* or *to guarantee* the teacher's RECEIVING PAYMENT if that amount of instruction *alone* be given"—a pretty plain hint that more than 28 lessons are necessary for even a chance of success, although it would appear that it was not considered, by the very well paid permanent officials, politic to state in exact words the time they thought necessary to be given, as it might have the effect of deterring many from becoming teachers under the system; and it might also have the effect of drawing greater public attention to the vast difference between the *precarious* sums the teachers earn and the *secure permanent* salaries the officials, who exist upon their labours, are paid.

In addition to the time that must be devoted to the teaching of the subject, the teacher of an Experimental Science will—if he illustrates at all, as he ought to do, his teaching by experiments—have to expend a not inconsiderable portion in their preparation: this will on an average amount to more than double the time he has to give to the actual teaching of the subject, and yet, after all the labour and time he may have bestowed, he is not sure under this system of any payment, however small, being awarded him; but even if he does happen to have awarded him the munificent sum of £1, we have learned from the letter of a Science teacher (p. 95) that he may not touch payment until thirteen months after he commenced his course of instruction.

Before proceeding further with the payment part of the

question, let me ask our Statesmen who are responsible for the Education estimates our Senators who vote the money, and the tax-payers who pay it, what benefits they expect the nation will derive from this Science teaching? If they take as their authorities on the subject those who are pecuniarily interested in maintaining the present system unaltered, a long list of benefits to be derived will be set forth; but in passing allow me to remark it is still *expectation*, not *realisation*; the ORGANISING SCIENCE MASTER, for instance, narrates a long list in his autumnal peregrinations through the country: he has been for the last year or two expatiating largely on the benefits our greatest industry, Agriculture, *will* derive from the Science teachers' instructions in the Agricultural Districts. The Lords of the Privy Council have been recently promising requisionists that Hygiene shall be added to the subjects taught: the Lords may promise, but where are the performers? Is the costly Department of Science and Art, unaltered and unimproved, to be continued the agent in the future for improving and extending the teaching in Pure and Applied Science, and to be depended upon for making the scientific education in England equal to that of Germany, and other countries more advanced than our own, in that branch of instruction at the present time? The Department cannot claim to have accomplished this in the past or the present, for they are still sending out Commissions—in addition to other independent, or nominally independent, Commissions—to continental countries to learn how it is to be accomplished.

Numerous letters are at present appearing in one of the London newspapers on the question "What are we to do with our Boys? The question came to be discussed by reason of an advertisement appearing for a clerk at a salary of £30 a year. This salary is thought by the writers of the letters as far too small, even for a *commencement*; but, small as it is, it is equal to the earnings of many of the Science teachers, and it is superior to the average payment per teacher, and the situation is preferable to that of the Science teacher in most other respects—the salary is secure; the clerk knows the exact day he will be paid; he will not have to wait nearly a year before he has a chance of receiving his small stipend; he has not to spend any of his leisure hours in preparing himself by *study* for his daily work; he has not to expend any of his small salary in purchasing books to fit him for and keep him abreast of his daily labour; he has not to work from 10 a.m. till 10 p.m. to earn his salary:

and he has opportunities for promotion: we have already learned how it fares with the Science teacher in these respects.

It is necessary, in order properly to estimate whether this Science teaching will have any effect in improving the industries of the country if the present system remains unaltered, to realise more thoroughly than we have yet done the teacher's position as regards the payment the State may award him. Each course of instruction must consist at least of twenty-eight lessons, and each lesson must last at least one hour, and for practical subjects an hour and a half; and even for non-experimental subjects a teacher cannot properly teach them without some preparation for each lesson,—say one hour is or ought to be devoted to preparing matter for the lesson; if an experimental science two hours more for preparing the experimental illustrations: in the latter case, therefore, four hours are or ought to be expended on each lesson. Now if the teacher is awarded any sum at all, it may, we have seen, be the munificent sum of £1 for his labour: this would be at the rate of less than twopence farthing per hour. If he was so fortunate as to be awarded ten times that—*viz.*, £10—it would amount to 1*s.* 9¼*d.* per hour.

The teacher cannot of course live on these small sums, and therefore, if Science teaching is his *sole* occupation, he must, in order to make a living, teach one or two subjects in half-a-dozen or more schools, or he must teach half-a-dozen or more Science subjects, knowing little or nothing about the majority of them (see pages 96 and 97), in one or two schools, and he must cram his pupils for the stage and class which offer him the largest chance of success, and this we learn from the numbers quoted in the Science Report is the lowest stage and the lowest class in that stage. And as long as this state of things continues what the Deparment's Examiners complain of—*viz.*, the conventional descriptions of pieces of apparatus which have never been seen, still less used; book-drill, in place of intelligent oral teaching; loading the memory with statements, with the sole object of reproducing them on paper at the Examinations, without at all understanding, or even attempting to understand, the Science to which these statements belong—must continue to be the mode of teaching under the system, because experience has taught the teachers that it is the one best adapted for passing the largest numbers, and, in addition, it is the only one they could possibly adopt when they have to be so

continuously employed in teaching, and unfortunately it is a system that places the incompetent and the competent educator on the same level.

Such teaching can never benefit the industrial world; it is more likely to have the contrary effect, for a little knowledge of the Inductive Sciences is a dangerous thing, if the possessor of the ill-acquired and unsound information of any one of them attempts to apply his so-called scientific knowledge to the improvement of any industry. I have given examples of this in my work "Education, Scientific and Technical; or how the Inductive Sciences are Taught and how they ought to be Taught," and I could, out of my own experience, add many more.

I must press yet another question on those of our Senators, whether they be landlords or manufacturers, who have to employ high-class labour, whether that labour be brainwork or handwork, if they can obtain it on the following terms: the payment to be so far uncertain that the labourer is to have no say as to what is awarded him; but even after some payment has been awarded him by one set of his employers' employees, another set of his employees can reduce the payment awarded by the former set, or even not allow any payment at all; yet these are the conditions the well-paid permanent officials at South Kensington impose on the Science teachers, and our Senators sanction it by voting the public money on these conditions, and yet they know by experience they are not able to obtain for themselves high-class labour on any such terms.

It may be replied that 1762 teachers have engaged on these terms; theanswer I make to that statement is this—that if these teachers, or any considerable number of them, are able on these terms so to teach their pupils, they become by reason of that instruction the improvers of the industries of the country, the sooner our Members of Parliament urge the Government to pay all the permanent officials, from the highest to the lowest, at South Kensington, in the same way the better, for then we should—according to these officials' doctrine—obtain the best labour at the cheapest rate.

It may also be urged, in reply, that the teachers are not altogether dependent on the payment on results, as fees are paid by some at least of the pupils: even if these fees are real in all cases—which I believe is not always the case—the total for the United Kingdom amounted in the year 1880-81 to £12,120 17*s.* 6*d.*: this divided amongst the total

number, 1762, would amount to nearly £7 for each teacher. The tax-payer may pay for instructing young men in Science at the Normal Science School at South Kensington, but it will be found in the long run that the most talented of them, after they have obtained the instruction, will not engage themselves as teachers on these terms, for they see not only the uncertainty which prevails as regards what may be awarded them for their labour, but they see also that their employment may be taken from them by an irresponsible official by the mere stroke of his pen, and the examples which show them the treatment they may be subjected to do not pass by them unheeded.

In each Annual Report of the Department the cost per head is stated, and, as I consider that the statement as given is most misleading, we will, in concluding the present article, briefly investigate it. It is stated in the 29th Report that "the average payment for each individual student under instruction was 14*s.* 2*d.*" for the sessional year 1880-81; this 14*s.* 2*d.* per head is arrived at by distributing the sum paid for results, *viz.*, £43,519 2*s.* 9*d.*, on the 61,177 pupils, and not on the number (about 26,000) which the teachers succeeded in passing, and which they were paid £43,519 2*s.* 9*d.* for passing. But if it was calculated on the number passed, does that represent the whole cost to the country? Has not the cost of the administrative machinery at South Kensington, the interest on the sum expended on the buildings, and the cost of the stationery and printing also to be taken into account? I think so, and I think all accountants would agree with me. With regard to the printing and stationery alone, Mr. Matthew Arnold, one of the chief inspectors in the Education Department, draws attention to the extravagance on these items in the Department of Science and Art.

(To be continued.)

VI. THE BRITISH MANIA.

By J. W. SLATER.

IT must not be supposed from this title that I am about to sit in judgment on the feeling which was once applauded as patriotism, but which is now sneered at by "advanced" speakers under a short and intensely vulgar name. My subject is the propensity, common among British naturalists, or rather I might say collectors, to confine their operations to the fauna, or the flora, of the United Kingdom, and to pass over those of the rest of the world with sublime indifference. Such persons, if, *e.g.*, engaged with the "study" of Lepidoptera, make it their life-object to get together a "complete collection"; that is, to accumulate British specimens of all the species of Lepidoptera known to inhabit the British Islands. In the pursuit of this task they are often so regardless of trouble and expense that sums of £5 and upwards are sometimes given for an insignificant moth, which, when acquired, proves nothing. At the same time a Continental specimen of the very same insect is often thought not worth accepting as a gift.

This propensity is, I believe, absolutely peculiar to Britain. I have known German entomologists, who, whilst rigorously careful concerning the locality of every specimen in their collections, and to note any local peculiarities which may occur, yet attach no especial value to any insect from the mere fact of its having been caught within the boundaries of the German empire. A Dutch, French, Swiss, Hungarian, or Danish specimen has for them the very same worth. Our true British maniac, on the other hand, often cares very little about the exact locality of his acquisitions. If they are only British,—on which point he is often deceived,—it is for him enough. But of this hereafter.

I will now ask, What constitutes a British species? A definite answer, based on a logical principle, is not to be found. It will not do to say anything captured within the four seas of Britain. All species or specimens of species found in Belgium or France are at once excluded. But a species or a specimen met with in Ireland, in the Outer Hebrides, or the Shetlands, is admissible. Twenty miles of sea form a boundary to the "British" district in one direction, but not in another. What is caught beyond the straits

of Dover is foreign; what is caught beyond St. George's Channel or the Pentland Frith is still "British." Hence the boundary might seem to be purely political, and the question might arise whether, in case of the secession of Ireland from the United Kingdom, its fauna would no longer be regarded as "British"?

But even this idea of a political boundary fails us. The Channel Islands, though politically British, are to naturalists of the class above mentioned, strictly foreign. Hence I feel free to maintain that the district to which our friends confine their attention is neither natural nor political, but a jumble of both.

But leaving this question to be dealt with by the British maniac at his leisure, it must be remembered that Britain is zoologically merely a much impoverished outlying district of the Palæarctic region and European sub-region, following the arrangement of Mr. A. R. Wallace. Its fauna differs from that of western and central Europe mainly by deficiency. France, Belgium, Germany, possess many species which we have not; we, on the contrary, can claim but very few species which are not found in them. Peculiar genera or families are out of the question. If, on the contrary, England had been separated from the mainland of Europe by a deep and ancient sea, as is Madagascar from Africa, and if its animal forms had been varied accordingly, the British fauna would then have been a worthy subject of the most minute study. Or if Britain had held an intermediate position between two great regions, or even sub-regions, in which their respective faunæ met and interpenetrated each other, the interest would have been still more profound. But the fauna of England depends merely (*a*) on the number of species which have survived the glacial epoch; (*b*) on the number of those which, on the cessation of that fearful calamity, had time to find their way over before the "silver streak" was interposed between Britain and the Continent; and (*c*) on the number which have, since that date, escaped destruction by man's interference. Hence the most faithful study of the present British fauna will throw remarkably little light on the principles of animal distribution.

Another objection to the British mania is that the work, whatever value it may possess, is overdone. Scores of collectors are all aiming at one and the same object, and attaining, more or less completely, the very same results, doing essentially over and over again what their forerunners had already accomplished.

A further misfortune is that the study of the entomology

of comparatively unexplored countries is thus seriously hindered. A traveller, let us suppose, has formed extensive collections in some such country, and in order partially to defray his expenses, he offers his duplicates for sale. Save for a few large and showy forms he finds that there is no *market*. Everywhere he hears the cuckoo cry, "I only collect British."

I will now glance at some of the excuses offered by the British maniacs for their singularity. The first is that a man may hope to get a "complete" collection of British species, but that if he extends his operations to the whole world, the task will be beyond his time, his space, and his resources. I should think, on the contrary, that the very finite character of an exclusively British collection, not an advantage, but a defect. At the same time, admitting that a general collection, even of a single "order" of insects, is beyond the scope of most private individuals, I submit that there are other modes of limiting our attention, which would be more interesting and more useful to science. The collector might limit himself to some particular family as occurring over the known world. Or, taking up the subject from a zoogeographical point of view, he might confine himself to some region or sub-region. A collection of the world's Carabidæ, Chrysomelidæ, Sphingidæ, Coreidæ, &c.; or, again, one of the Lepidoptera of the Mediterranean basin, or of the Neuroptera of the Antillean sub-region, would be far more instructive than the everlasting British displays that meet our disappointed gaze. But do such collections, complete or otherwise, exist?

Another very common plea is that of convenience. It is easier, we are told, to form a British than a foreign collection. This is, at the present day, very doubtful. The collector who wishes to capture his specimens personally, will find an entomological tour in many parts of the Continent easier and cheaper than, say, a visit to the Shetland Islands, the Hebrides, the west of Ireland, &c. Abroad, too, he will be less inconvenienced by the trespass laws, which, in all ordinary circumstances, do not extend to waste lands, heaths, deserts, &c., as they do in this our highly-favoured country.

If he wishes to form his collection by purchase, he will find foreign specimens cheaper than British, and more frequently genuine. It is a fact that so-called British specimens of insects, birds, eggs, &c., are very frequently obtained from abroad, even from Siberia or Western Asia. Now, as many species vary locally, serious errors are thus

introduced. A bird's egg is sold to a collector as "British." True, the species of bird occurs more or less frequently in Britain, but the egg in question was laid in Norway!

Again, it may be asked, especially in case of strong-flying birds and insects, When have we right to call them British? A solitary specimen straying hither, or even driven over by a tempest, from the Continent or from America, has very doubtful right to be so classed. Even if such occasional stragglers remain and breed with us for a season or two, we cannot consider them as true natives. But, according to the prevailing code, every such visitor is British, and is accordingly shot down, or otherwise captured. This, though the last, is certainly not the least, objection to the British mania. Not merely all such occasional wanderers, but many unquestionably native species, are in a fair way for extirpation, owing to the high price set upon their heads. One of the most efficient means to ensure their preservation would be the abandonment by our collecting naturalists of the British mania, with all its narrowness, its pettiness, and its gullibility.

Finally, I may point it out as curious that, with all this apparent desire for a thorough knowledge of the fauna of our own country, and with such numbers of collectors, all the orders of insects but two are practically neglected.

ANALYSES OF BOOKS.

*Darwin considered as regards the Causes of his Success and the Importance of his Works.** By M. Alph. De Candolle. Geneva: H. Georg, University Publisher.

In this little work the distinguished author gives a vivid and truthful survey of the condition of the organic sciences shortly before the time when the "Origin of Species" made its appearance. Naturalists had become profoundly dissatisfied with the labour of describing and distinguishing species. They were driven to admit that the limits of species became the more vague and fluctuating the more closely examined. The alleged physiological criterion, the power of mutual reproduction, broke down. Thus M. Naudin showed that two species of *Luffa*, clearly distinct morphologically, were yet capable of mutual fecundation. Palæontological discoveries showed a successive diversity of beings which could not be accounted for by Cuvier's theatrical hypothesis of sudden, successive creations and extirpations. The author, four years before the appearance of Darwin's great work, showed ("Géographie Botanique Raisonnée") the appearance, in certain cases, of new forms derived from former ones, and proved further that species had passed through and survived geological and climatic changes. At the same time the astronomical notion of unlimited time, the embryological researches of Baer, and the more intelligent study of monstrosities, all combined to shake the unsatisfactory fabric of the Old Natural History. The hour therefore had come, when the man appeared. Half a century earlier Darwin—like Lamarck, Oken, Goethe, Wells, or his own grandfather Erasmus—would have found the world not prepared for his revelations.

We cannot omit here to notice a brief digression. M. De Candolle calls attention to a forgotten writer, A. M. Duchesne, who, in a "Natural History of the Strawberry," published twenty-four years before Goethe's "Metamorphosis of Plants," and thirty-five years before the earliest of Lamarck's works, announced that "the genealogical order is the only one which Nature indicates, the only one which fully satisfies the mind; every other classification is arbitrary and void of ideas." He even proceeded to draw up a genealogical tree of the strawberry, much as is now done for animal groups by Prof. Haeckel and

* Darwin consideré au point de vue des Causes de son Succés et de l'Importance de ses Travaux.

others. Yet Duchesne, in this respect, was so completely ignored that M. Silvestre, his conscientious biographer, in delivering his *éloge* before the Royal Society of Agriculture, entirely overlooks this point.

But M. De Candolle, whilst fully recognising that the time for a grand re-organisation was come, admits also that for the task Darwin was needed. He doubts whether even Mr. A. R. Wallace, the co-discoverer of the hypothesis of "Natural Selection," could in the absence of Darwin have secured its acceptance. He considers that among naturalists Darwin alone had the exceptional power of concerning himself with the most trivial facts and with the loftiest generalisations.

M. De Candolle notices Darwin's peculiar conduct towards his adversaries. He evidently had no love for polemics. Instead of answering he pursued his way. In particular he never attacked religion, and his results are now more and more widely accepted by Divines as hostile neither to Theism nor to Christianity.

In conclusion the author describes a visit which he paid Darwin in the autumn of 1880, on which occasion he found the veteran naturalist "more animated and apparently happier" than at their last interview, forty-one years previously. This fact may seem trifling. We commend it to the notice of the author of that strange pamphlet "All the Articles of the Darwinian Faith."

In a note M. De Candolle pronounces the term "transformism" preferable to "evolution," since the successive changes of forms are not always in the direction of a higher development. The word transformism may comprehend all the modifications of forms in whatever direction they may proceed.

On the subject of degeneration he remarks that "Mr. Ray Lankester published in 1880 a small volume entitled 'Degeneration, a Chapter in Darwinism,' without suspecting that degenerations and abortations were among the principal subjects of the elementary theory of Botany, by De Candolle." He refers to the edition of 1819, page 105.

The present work may be pronounced an accurate and luminous epitome of the history of the Darwinian movement in natural history.

The Creed of a Modern Agnostic. By RICHARD BITHELL, B.Sc., Ph.D. London: G. Routledge and Sons.

THIS book touches upon and occasionally enters into regions which lie beyond our legitimate cognizance. The author seeks to rectify certain current notions concerning Agnosticism. He

tells us that it does not mean one who knows nothing, or who professes to know nothing. He refers, in a note, to Mr. Tennyson's poem "Despair," in which occurs the popular phrase "their know-all and know-nothing creeds," and remarks "It is scarcely possible that Mr. Tennyson can have been so imperfectly acquainted with the views of Agnostics as to suppose that they professed to *know nothing*." He tells the reader that "Agnosticism is a theological term, and is applied in a strictly limited and conventional sense to a class of thinkers and writers who believe that there are certain things connected with Religion and Philosophy which we not only *do not know*, but which we have no means of knowing, simply because we have no faculties by which we may get such knowledge." He draws a clear, and, we admit, a tenable, distinction between the Agnostic and the Atheist. He rejects the common insinuation that Agnosticism is "a refuge for the thoughtless and the mentally ignorant." He considers that the publication of the work before us has become a "pressing necessity." He claims no right to speak on behalf of others, and admits that Agnosticism has not been formulated as a definite creed. But he insists that in the sermons and theological works of the last forty years there "appears a reticence of speech, a modesty of assertion, and an absence of false assurance, which are eminently characteristic of the Agnostic spirit."

After these introductory explanations Dr. Bithell lays down a series of six propositions, which we quote, though we cannot enter into their formal discussion:—"Of transcendental truth, absolute truth, of pure being, of things in themselves, man knows nothing; nor does it appear that in the present stage of human development he has the mental faculties for acquiring such knowledge." "There is a large body of practical truth accessible to the human mind which we are capable of knowing as positively as we can know anything, *not absolutely*, but with a certainty beyond which we have no interest in knowing anything." "Between the domains covered by the known and the unknowable there is a vast unexplored region of unknown but knowable truth, which constitutes the proper and legitimate field of speculation and research." "There are many things which we *believe*, but which we do not *know*; and we believe those things either on account of the evidence by which they are supported, or because we have to some extent the means of verifying them." "The proper objects of human knowledge and belief are phenomena,—that is, the forms and modes in which the Unknowable manifests itself. These manifestations, as they affect the intellect, furnish the groundwork of Science; as they affect the emotions, the rudiments of Religion." Lastly, "Morality has its origin in human needs arising from the instinctive desire of individuals to form themselves into social groups; it is often enforced by sanctions embodied in religious creeds, but

exists before and independent of them; it also becomes more imperious in its demands as societies become more highly organised."

In the development of these propositions the author expresses occasionally views which are open to discussion. We turn, *e.g.*, to his interesting attempt to explain the existence of evil. "Evil," he writes, "both physical and moral, is seen to indicate nothing more than the development of higher sensibilities and more acute powers of discrimination." In working out this supposition he tells us that "passing from the contemplation of vegetable to that of animal life an enormous increase in the complexity of the organisations is presented to our view, and a new phenomenon appears in the *evolution of physical evil or pain*." Now Dr. Bithell must be aware that there is no sudden enormous increase of complexity observed in passing from the vegetable to the animal world. There are animals simpler in their structure than are many plants, and that there are beings holding a doubtful position,—even some capable of being regarded as morphologically plants, but physiologically animals. Surely it is rash to say that all animals are sentient, and all plants unconscious, insentient.

In like manner the author, in accounting for moral evil, seems to us to make a far too absolute boundary between the lower animals and man. He writes:—"It does not appear that a sense of wrong, or the opposite principle of right, is felt by any other part of the animal world." Again, "All those acts which when done by human beings we call *sins*, crimes, and *misdemeanours*, are if done by the lower Mammalia regarded without moral disapproval; and the difference in our estimate of the acts in themselves, [incomplete?] but from the consciousness that we have faculties by means of which we discern the moral character of these acts. This we believe the brute creation cannot do."

Against all this we must put in a most decided protest. We have distinct evidence that amongst social animals there exist the rudiments of positive law. Offending ants, rooks, &c., have been observed to be punished not by the individual aggrieved, but by the community. Correction, and even death, is inflicted in cases where there has been transgression not against any individual, but against the supposed interests of the community. Now law presupposes a recognition of the difference between wrong and right, and is in its absence utterly inconceivable. Our belief that the brute creation cannot perceive the moral character of certain acts is an unproved assumption.

Elsewhere the author writes:—"While primitive man had nothing but articulate speech, his individual experience died with him." Does the author mean to convey the notion that primitive man had always articulate speech? Does he hold that experience cannot be transmitted without such speech? We

believe that knowledge was to some extent handed down in the human species prior to the development of speech, as we see among the lower animals.

There are other passages on which issue might be joined in the columns of journals devoted to theological, historical, or political questions, but into which we cannot enter. The work, whatever may be thought of the subsidiary opinions here and there expressed, is at any rate a fair, temperate, and clear exposition of the creed of the Agnostic. Those who study it may be preserved from errors misleading to the public and discreditable to themselves.

The School of Mines and Industries, Ballaarat, Victoria, Australia. Ballaarat Science Lectures. First Series, 1882. A Course of Popular Science Lectures delivered in the Lecture-Hall of the School during the Winter of 1882. Ballaarat: James McHutchison.

Of these Lectures several are of decided interest, and may fairly claim our notice.

In a discourse on Alchemy, delivered by Mr. G. Foord, of the Royal Mint, Melbourne, the speaker noticed the belief, common in the days of Queen Elizabeth, that worms, snakes, and eels might be produced by fermentation. It would seem that in some parts of Scotland, even to the present day, it is half-believed that a horse-hair placed in a cask of water will gradually become an eel.

The Rev. T. E. Ick, M.A., gives an able Lecture on the Wonders of Coral Life. His treatment on the subject is fully on a level with the latest results of investigation. He brings forward a teleological explanation of the fact that the trees on a coral island grow densest and highest on either side of the opening into the lagoon, and finds here a special arrangement for the safe guidance of mariners. We would remind him that as "it is an ill wind which blows nobody good," so it must be an exceptional circumstance indeed which has not a useful phase.

Dr. J. F. Usher takes for his subject Human Physiology, under the title "Body and Bones." His Lecture has rather, if we may use the expression, a buffo character. He ventures on the statement—"A physiologist lately declared that he thought he had conclusively proved a certain point after he had vivisected or otherwise experimented on 4000 dogs, but that on similarly experimenting on 4000 more he found his first conclusions wrong." The internal evidence of this case is so doubtful that we must take the liberty of asking whether the authority is Baron

Munchausen or "Ernst Von Weber"? Further, the lecturer tells us that "within the last few months Dr. Koch, a Berlin physician, has proved to demonstration that that fell disease phthisis, pulmonary or tubercular consumption, is due to the presence of a certain parasite called a bacillus." Without entering upon the discussion of this theory, we must remind him that he might have looked nearer home, and found in Dr. W. Thomson, of Melbourne, probably the earliest—and certainly an independent—author of the discovery; for which, however, he has reaped as little *kudos* as did Dr. George Walker, the *true* apostle of sanitary reform in England.

Passing over a handful of jokes and a good sturdy denunciation of tight lacing, we come to the peroration. The lecturer said, if "the undevout astronomer is mad, no less, I think, the undevout physiologist. Yet Tyndall and other great scientists were never thought either mad or pious." We do not see why Prof. Tynda ll, the physicist, is here paraded at the close of a Lecture on Physiology, unless it be for the sake of introducing the very threadbare subject of the Belfast Address. Dr. Usher goes on to say—"It is incomprehensible to me how men . . . . nevertheless reject a designer, as everyone must acknowledge who reads Tyndall's Belfast Address between the lines,—rank Atheism, thinly veiled throughout." Might it not be suggested that "reading between the lines" is a very difficult process, by which, moreover, we may sometimes get out of a book something very different from what the author ever put into it?

The lecturer proceeds:—"One great German scientist now lives with altered views, and an eminent French one lately died as we all would wish to die." These are but very vague assertions.

Again, returning to Tyndall, Dr. Usher pronounces him "*facile princeps* of them all," *i.e.*, of men of Science, and even calls him "a man whose discoveries in light and sound alone would make even the great Newton, if now alive, sit as the humblest of his pupils at his feet!" We doubt if many continental authorities would endorse this high-flown encomium.

Baron F. Von Müller, F.R.S., the Government Botanist of Victoria, gives a most interesting Lecture on the Flora of Australia as compared with those of New Zealand, of New Caledonia, of Europe, of Japan, of Chili, of New Guinea, and of the United States. The learned speaker concluded with some remarks which seem to breathe a spirit of hostility to the doctrine of Evolution. His principal contention is apparently that species once extirpated are never restored to vitality. But in like manner the individual defunct animal or plant is never restored to life. Yet this is no argument against the fact that it has gradually sprung from an initial germ!

Electricity and its Uses. By J. MUNRO. London: The Religious Tract Society.

WE have here a popular, but clear and correct, account of electrical science in all its various branches. A work of this kind was greatly needed. We have indeed, in the English language, books which treat of electricity in a manner suitable for the student or for the professional specialist; but if an educated and intelligent non-specialist had asked us to recommend him a book giving a brief and plain account of the recent applications of electricity, of their results, and of the principles upon which they rest, we should have felt no little perplexed.

Hence it is no wonder if the popular notions of electricity are of the wildest. It is credited with the strangest and the most contradictory attributes, and is recommended by those who know least about it for effecting any purpose soever. We trust that some at least of these vain imaginings will fade away into the "infinite azure" as Mr. Munro's little book becomes better known.

The author's plan is very simple: he describes and illustrates the leading properties of the agency in question, and then proceeds to show their applications. Thus we have, first, a sketch of the early history of the science, a notice of the rival hypotheses of two fluids, and of one which, though no longer recognised by electricians, still survives, for convenience sake, in their current language. We are then successively introduced to batteries, to polarisation, circuit, resistance, the electromotive force, and Ohm's law. In successive chapters follows an account of induction, a notice of the telegraph, telephone and microphone, of the photophone and telephotograph, the induction balance, the dynamo-electric machine, the various arrangements for the generation of the electric light, and a summary of its advantages as compared with gas,—once the admiration of our fathers, but to us a mere nuisance, especially where supplied by a monopolist company.

We have next an account of the applications of electricity for the transmission of power and for storing up the effect of certain natural agencies, such as the winds, the tides, waterfalls, &c. It may here be mentioned that Mr. Edison hopes ultimately to obtain an unlimited supply of power from the electric currents of the earth and the atmosphere, thus dispensing with the steam-power and the consequent consumption of coal for setting dynamo-machines in action. The transmission and distribution of mechanical power—just as we now lay on water or gas—rightly seems to Mr. Munro to open up a hopeful social prospect. He writes:—"The great economy of very large steam-engines over small ones has led to the development of large factories, where hundreds of human beings are cooped up amid the in-

cessant roar of machinery and the stifling dust of a polluted atmosphere. But when power has been distributed by wire to this place and that, a blow will have been struck at this imprisonment of men and women in the interests of capital and the consequent deterioration of their souls and bodies."

We fully admit that the factory system has made "wealth accumulate and men decay," and we most devoutly hope that Mr. Munro's anticipations may be fulfilled. But so far all the potential benefits offered us by modern science have been neutralised or turned into curses by modern greed.

The last two chapters treat, somewhat briefly, of electricity as a source of heat, of electro-chemical action, and of medical electricity,—a region in which there is yet much to do, especially as regards taking the matter out of the hands of quacks.

The question may be asked, Why is it that electricians, having done so much for our hearing, have as yet done nothing decisive to extend the action of the noblest and the most important of our senses? Reports, indeed, reach us from time to time of inventions by means of which a picture of what is taking place miles away, or in a closed apartment, may be presented to our view; but as yet this is not confirmed. Another improvement much wanted is the translation of light into some other form of energy, capable of affecting the nerves of the blind, and thus depriving this infliction of its sting. Perhaps some future Edison may solve these problems, and thus eclipse the telephone.

Mr. Munro's book deserves our most cordial recommendation. Amongst its good properties we must not overlook the fact that it has not been written in the interests of cram and examinationism,—the Chinese leprosy now overspreading our country. The volume is admirably got up, and is liberally illustrated.

German Conversation-Grammar, in Three Concentric Courses. A Method for Teaching the German Language thoroughly, and in the Shortest Time possible. Containing Grammar, Exercises, and Reader, with Dictionary. By J. Sydow, Graduate of the University of Bonn. Paris: J. G. Fotheringham. London: Kent and Co. Edinburgh: J. and J. Clark.

Concerning the value of the method of learning the German language as here given, we can scarcely undertake to pass a decided judgment. The author in his Preface states that, though called a "Conversation-Grammar," his work is totally different from those school-books which go by this name. . . . All the

translations and exercises, while exemplifying the grammatical rules, embody them in sentences which make sense with one another." By way of explanation he gives in parallel columns two exercises, the one of the kind usually to be found in conversational guides to languages, and the other on his own principle. He points out that the former of these requires a knowledge of the auxiliary verbs, the plural of nouns, and the use of prepositions, thus requiring the expenditure of "more than a couple of months on a work with little or no profit." The other, on the author's system, composed without any case-inflection, can be managed "at least [at most ?] in a month, with an evident advantage for conversation."

The exact meaning of the expression "concentric courses" scarcely appears. The author's English is by no means idiomatic. Thus we read in the Preface:—"The Middle Course completes etymology in a systematical way, altogether with the teaching of the construction of the subordinate clause. The student, having got sufficient knowledge of the structure of the language, ought to become acquainted now with those parts of grammatical construction which if exposed to him at the beginning would only have been a hindrance to his progress. . . . The author believes having treated this matter in a manner so as to enable the student," &c. Various other erroneous or awkward expressions will be found here and there in the book. Still as the author's purpose is to teach German, not English, these defects will not be of great consequence. The number of typographical errors is also very considerable, at least as far as the English words are concerned. Very possibly, however, had the printing been done in England the German portion would have fared at least as badly, whilst in France both would have been murdered.

Longman's Magazine. No. XI. September, 1883. London: Longmans and Co.

THE scientific element in this number consists in an interesting paper, by Mr. J. A. Farrer, on the Age of Trees. Our knowledge of this subject is, as the author rightly declares, "little more than guess-work." Neither the girth, nor the number of rings, nor tradition is any safe guide. Concerning the latter Mr. Farrer is decidedly sceptical. To confess the truth, it might be hard to give any proof that the hollow of the Shambles' Oak, in Sherwood, served Robin Hood and his merry men as a place to bestow the carcasses of slain deer till their banquetting hour. Nor would we undertake to show that the "Parliament Oak," of the

same region, is the identical tree under which Edward I. and his barons consulted before the final expedition against Llewellyn of Wales.

A short tale, entitled "A Bookman's Purgatory," contains a suggestion. The hero of the story collects stray copies of the youthful literary efforts of men who have since become famous, or at least notorious. Such a collection of indiscretions, to be delicately alluded to on occasion, would be exceedingly useful in an editorial sanctum. Yet, after all, the British public rather admires defiant inconsistency, and would think no worse of an idol because his former opinions were diametrically opposite to those which he now advocates.

Traité Pratique de Botanique; Propriétés des Plantes: leur Utilité et leur Emploi dans la Médécine, la Pharmacie, les Arts Industriels, l'Economie Domestique, &c. Par Ed. Lambert. Paris: Firmin-Didot et Cie.

M. Lambert begins his task with some remarks on the importance of Botany nowise novel, and conceived, perhaps, more in a utilitarian than in a truly scientific spirit. He regrets that so many of the affluent and leisurely classes prefer dissipation of all kinds to the study of Nature. He protests against the mistake of attending only to rare species, leaving the commoner kinds unnoticed. He recommends that botanical excursions should be undertaken in company, which, however, should be select, comprising merely persons of suitable tastes and habits. In public herborisations distraction and amusement are often kept more in view than scientific observation.

The travelling botanist is next advised on the subject of his costume. He is told that light grey is, *per se*, the best colour for clothing, but that "the naturalist, less than any other traveller, should render himself conspicuous. This caution is not to be despised, for with a great part of mankind any person whose aims and pursuits are unknown is regarded with suspicion.

We next find certain rules to be observed when travelling. These regulations are of course adapted to the laws and customs of France. Thus we read:—"The character (*qualité*) to be assumed on the journey is not a matter of indifference; that of a soldier, a merchant, even that of a naturalist, exposes you, under certain circumstances, to delays and questions on the part

* Practical Treatise on Botany; Properties of Plants: their Utility and their Use in Medicine, Pharmacy, the Industrial Arts, Domestic Economy, &c.

of custom-house officials and gensdarmes, and even of game-keepers, which it is well to avoid. The character of a Professor is the best for avoiding impertinent questions."

In the British Empire, fortunately, a man is not asked, when travelling, as to his profession or his purposes, though in the home kingdoms the gamekeeper is sometimes very rampant and troublesome. But on the Continent any gensdarme is at liberty to examine the traveller, and so on frontiers is the revenue-officer. We once, on the Austrian boundary, routed a troublesome member of this fraternity by opening under his nose a box containing some live specimens of the salamander. "Holy Nepomuck, pray for us sinners!" was his ejaculation, as he rushed frantically away from animals supposed so deadly.

M. Lambert's advice to the travelling botanist is singular:—"I recommend to carry with you a bottle of ammonia and another of volatile alkali, in case of experiencing sunstrokes, the stings of insects, of vipers, the bites of rabid animals, &c."

"Volatile alkali" is generally regarded as an antiquated synonym for ammonia, though some, we believe, apply it to ammonium carbonate. We can certainly recommend it for the bites of vipers and for the stings and bites of many insects, though not for that of the harvest-bug, which requires the application of dilute carbolic acid. For the bite of a mad dog its value would be trifling indeed.

After instructions on the choice of paper and presses, the author points out the seasons most advantageous for the field-botanist in the different parts of France, with regard to such stations as walls and ruins, fields and meadows, woods, marshes, mountains, and the sea-shore.

After this introductory matter, much of which will prove very useful to botanists travelling in France, the author proceeds to a systematic account of the vegetable kingdom arranged according to their families. The structural characteristics of the most important forms are shown by means of numerous illustrations, and the geographical distribution of each family is not forgotten. A very convenient feature of the book is that it gives the French trivial and local names of the principal plants, in addition to the scientific nomenclature.

The author does not enter into vegetable physiology. He regards also apparently every species as an ultimate and independent fact. Hence he belongs, apparently, to the Old School of Natural History, with its characteristic limitations.

Honour to whom Honour is Due. Edward Davy and the Electric Telegraph, 1836 to 1839. By J. J. FAHIE. Reprinted from the "Electrician," Vol. XI., 1883. London: James Gray.

Short Memoir of Edward Davy, M.R.C.S. By HENRY DAVY, M.D. Reprinted from the "Electrician," No. 11, Vol. XI., 1883.

THESE two pamphlets may be most conveniently noticed together. It appears that even in this enlightened age not merely the emoluments, but even the honour of an invention, are not equally distributed. We have been familiar with the telegraph for nearly forty years, and we have heard no little discussion as to the comparative merit of its originators and improvers; but till quite lately none of us heard of one who may fairly rank as an independent co-inventor, even if he did not actually anticipate Cooke and Wheatstone. In the documents before us it is expressly stated that Davy had a clearer grasp of the requirements and capabilities of an electric telegraph than probably Cooke and Wheatstone themselves! In 1837 he predicted the use of submarine cables, hinted at the telephone, or a system of "electroloquism" as he called it, and prophesied that the "Government would adopt the telegraph as a part of their postal system. In 1836 he had a clear knowledge of the fact that the effect of the current on the needles could be increased by multiplying the convolutions of the coil. Into a knowledge of this fact we read that "Cooke and Wheatstone and Morse blundered painfully." In Davy's MSS. which have recently come may be traced the principle of the axial magnet used in Royal Houses' telegraph, the germ of the Morse system and of the Brown and Allan relay.

We may now ask who was this Edward Davy? Though a West-country man, he does not appear to have been connected with Sir Humphry Davy. His father, Thomas Davy, of Ottery St. Mary, was a pupil of Sir Astley Cooper, and had an extensive medical practice. Edward Davy was educated as a surgeon, but a so-called medical practice which his father bought for him in the Strand turned out to be merely the business of a pharmacist. He published a small book entitled "Experimental Guide to Chemistry, improved several articles of apparatus, and issued a trade-catalogue of chemical appliances and chemicals. About 1835 he began to experiment on the electric telegraph, and with astonishing success; but, like many men of genius, he had no business capacity. He exhibited his machine in Exeter Hall before it was patented, and his exhibition, as is here stated, was visited by Cooke, Wheatstone, &c. What made his invention a failure, as far as he himself was concerned, was his emigration

to Australia in 1839, considering that his invention was completed, secured, and made known, and that nothing remained but negotiations which might be left to agents. The agents, however, did not push the matter, and so Davy's patent fell into the background. It is interesting to add that the inventor is still living in Australia, honoured and prosperous. For many years he was assayer to the Mint at Melbourne, and for the last quarter of a century he has carried on, in partnership with one of his sons, an extensive medical practice. But until the recent discovery of his MSS. (of the existence of which the family were not aware) by his nephew, Dr. H. Davy, of Exeter, and their examination by Mr. J. J. Fahie, his claims as the inventor of an electric telegraph had lapsed into oblivion. His models and apparatus had been sent down to Ottery St. Mary in 1840, and stowed in an outhouse. By occasion of a removal, about three years ago, they were sold as old metal. Mr. Fahie could only find half-a-dozen old Daniells, and a few pieces of copper-wire. His MSS., we are happy to learn, will shortly be committed to the safe keeping of the Society of Telegraphic Engineers.

The Prophylactic Power of Copper in Epidemic Cholera. By Arthur de N. Walker, M.D. London: Epps.

The recent revelations of M. Bailly, showing that workers in copper do not enjoy any uniform immunity in case of cholera, render it unnecessary for us to discuss this pamphlet.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

SEX INFLUENCE ON THE DEVELOPMENT OF SPECIES.

To the Editor of the Journal of Science.

SIR,—If we stop in our progress backwards where the Kingdom of Nature first carries on its evolutions by the outcome of the contact of two opposites, at the first "female" and "male" existence (however such a difference originated, if we can conceive a state where it did not exist), may we not cast about for a solution there for the origination of varieties, species, and, in the end, sub-kingdoms? Of course it may be objected at once that, when such a state was arrived at, the stone had been set rolling, and the inherency of development was in being. But what I am arguing is, how much the opposite influence of the individuals of each pair of the same variety has affected the opposite sex in the offspring.

It is a matter of astonishment that the animal kingdom always produces itself so faultlessly, when we look at it; and yet why should it be otherwise? It must be admitted that development has been very minute in each stage, and of wide interval. The question remains, What is it that has given rise to any variation, any accident, any monstrosity (as it is)? A long way on we might think a pair's constitution was so weak that it failed to bring forth its own likeness exactly, but something partly like itself and partly like a remote ancestral form, up to which stage of development the constitution of the parents has only strength to bring it; for surely a more highly developed existence requires a great effort of the constitution, or a "something" vital?

But when we notice the effect of crossing very near varieties, such as different kinds of sheep, for instance, is not the decided predominance of the male, or the greater predominance of the female, in the offspring surprising and suggestive? They are no mean halves of the two, as any treatise on breeding will inform us. With domestic pigeons, if two differently coloured

birds be paired, the one or the other is often strong enough in "something" to produce its own colour in the offspring. I have crossed a yellow Jacobine (a prize bird) with a common blue hen, and in one nest I have had blue young ones like the mother, and in the next yellow ones with white head and tips (and a very poor ruff). This shows a wavering of the two constitutions, though I believe some pairs breed a constant result in colour, often neither like one nor the other. The age of the respective birds seems to have an effect on the sexes as well.

And let us look amongst ourselves: it is in every one's observation to see, in different families. how some all "take after their mother," or "after their father," in particular physical and physiological items, often all on one side. There is a stronger —what? in one parent. Nor is it absolutely a matter of health, as many know to their sorrow; for evil seems to dog the steps of man far more than good does!

It may be admitted, one would think, that this "cross"—so to speak—of the sexes has its influence in producing varieties. The first variety must have originated in the same kind of individuals, when there were no opportunities for crossing; and if it *must* have been so once, who can say how important a factor it has been since?

Two constant proportions of atoms in chemistry will give a constant result; vary one ever so slightly, and you get nothing, or a very distinct result—a "new variety." And although it seems very far-fetched to consider human beings as two chemical elements, it is easy to see, howsoever one may acquire a slight over-proportion of this mystic "something," the result must be a new variety.—I am, &c.,

D. Yewdall Cliff.

MODERN INVENTIONS ANTICIPATED.

To the Editor of the Journal of Science.

Sir,—Having read with much pleasure, in your September issue, Col. A. Parnell's article on the "Origin of Lightning Rods," I was surprised to find that, according to M. A. De Rochas ("La Nature," 1883, p. 381), Franklin must have been anticipated in very remote antiquity. It is said there that the ancient Etruscans understood the art of guiding the lightning. Servius relates that in ancient times the priests caused their sacrifices to be ignited by lightning. Tullus Hostilius on such an occasion was struck dead because he neglected the precautions given by Numa.

The same author shows also that burning-glasses have been known from time immemorial, and are mentioned in the "Clouds" of Aristophanes, whilst a plano-convex lens has actually been found in the Ruins of Nineveh.

M. De Rochas, in an earlier portion of the same volume of "La Nature," mentions also that fire-engines were known to Hero of Alexandria, and were described by him clearly in his "Pneumatika." They were improved, according to Vitruvius, by Ctesibius, and were hence known as the Ctesibian machines. In the Dark Ages they were lost sight of, and were re-invented at Augsburg early in the sixteenth century.

Now, Sir, I would not have troubled you with a mention of these facts were they merely historical curiosities; but they seem to me instructive. They prove that useful arts and practical inventions, and perhaps a body of Science from which they were derived, may be lost sight of and afterwards may be re-invented. Hence it is at least possible that arts may have once flourished which have been forgotten, but have not been recovered. In any case it is certain that the career of mankind has not been one of unbroken "progress."

I may venture, further, to suggest that the occult knowledge claimed by certain mystics may be simply a more or less fragmentary relic of what was once commonly known. Have we not in the above, too, a natural explanation of the miraculous "fire from heaven" which occurs in the mythologies of various nations?—I am, &c.,

A LUCRETIAN.

INJURIOUS INSECTS.

To the Editor of the Journal of Science.

SIR,—I was much surprised to find, a few days ago, the folllowing assertions in a widely-circulated paper:—"Wherever these troublesome pests [apparently house-flies] abound we may always find consolation in the knowledge that they absorb impurities which would otherwise cause far more serious inconveniences than any that can be fairly ascribed to the buzzing restless little pests themselves."

Again, in the same leaderette is to be read—"If the daddy-longlegs cannot give so good an account of himself as this, he can at all events defy the breath of slander to sully the harmless reputation of his brief existence." (!!)

To take the latter of these two assertions first, I noticed many years ago that the daddy-longlegs, when in the larva state, cuts off seedling plants just under the surface of the ground, so that they perish. On referring to standard authorities to see if the observation was novel, I found it recorded by Professor Westwood, as far back as 1840, in his "Modern Classification of Insects," that "This is particularly the case with *Tipula oleracea*, the larvæ of which sometimes thus completely lay bare wide tracts of meadow." Anyone who consults more recent authors on Economic Entomology—*e.g.*, Miss Ormerod—will find that this supposed "harmless" creature for destroying grass and corn may rank with the wireworm.

The theory that house-flies and other Dipterous insects are safe and useful scavengers is equally erroneous. They "absorb" putrid and morbific matter, and convey it into our food and our very blood, and thus convey carbuncle, ophthalmia, leprosy, &c., from one patient to another. This I submit is a somewhat "serious inconvenience." One of the saddest features of the day is that persons come forward or are set to write on subjects about which they have no special knowledge.—I am, &c.,

S.

THE APPOINTMENT OF A PUBLIC EXECUTIONER.

To the Editor of the Journal of Science.

Sir,—Surely in these enlightened days an appointment of such importance as that of Public Executioner will not be left to "influence or nepotism." I hope to see the announcement in due form that an "open competition" will be held, and that intending candidates must prove their competency by submitting to an examination.—I am, &c.,

R. M. N.

NOTES.

Biology in the German, Austrian, and Swiss Universities. Winter Semester.—The following Professors and Assistants give instructions in the different departments of Biological Science:—

Basle: Rütimeyer, natural history of the Vertebrates; Vöchting, general botany and microscopy; Griesbach, general and special zoology.

Berlin: Schwendener, general botany; Westermaier, vegetable physiology; Magnus, botanical colloquia; Von Martens, systematic zoology and zoological colloquia.

Bern: Fischer, botany; Bachmann, palæontology; Studer, general zoology and zoological exercises.

Bonn: Pohlig, fossil Mammalia; Schlüter, introduction to original work in palæontology; Strassburger, special botany, microscopic botany, and introduction to original work; Hertwig, zoology; Bertkan, practice in determining animals.

Breslau: Schneider, zoology and zoological practice; Cohn, fungology, principles of general botany, and vegetable physiology; Rœmer, palæontology.

Dorpat: Rosenberg, evolution of the Vertebrates; Grewingk, palæontological practice; Klinge, general botany, determination of plants, and botanical excursions.

Freiburg: Hildebrand, microscopic botany; Weismann, zoology; Gruber, zootomical practice.

Giessen: Hoffmann, vegetable physiology and general botany; Ludwig, zoological practice,

Graz: Leitgeb, general botany; Von Ettingshausen, vegetable palæontology; Haberlandt, vegetable physiology; Schulze, zoology, with demonstrations and work in the Zoological Institute.

Halle: Von Fritzsch, palæontology; Grenacher, systematic zoology and animal morphology.

Heidelberg: Bütschli, zoological practice and demonstrations; Kossmann, zoological laboratory; Pfitzer, systematic botany and work in the Botanical Institute.

Jena: Preyer, physiology, introduction to research in the physiological laboratory; Haeckel, zoology, with practice and introduction to research; Stahl, principles of botany, practice, and research; Detmer, experimental vegetable physiology.

Kiehl: Möbius, zoological practice; Engler, vegetable morphology and physiology.

Leipzig: Schenck, experimental vegetable physiology; Leuckart, zootomic practice; Chun, zoology; Marshall, the Darwinian theory; Fischer, morphology of mosses.

Munich: Hartig, anatomy and physiology of plants, with microscopic demonstrations, microscopic practice for advanced students; Von Nägeli, systematic botany; Zittel, palæontology; Spangenberg, zoology.

Prag: Gintl, palæontology of the Evertebrates, and the Darwinian doctrine with reference to palæontology; Weiss, general botany, and use of the microscope; Von Stein, general zoology.

Strassburg: Benecke, palæontology; De Bary, work in the botanical laboratory; Schmidt, zoology, and work in the Zoological Institute for advanced students.

Stuttgart: Jäger, zoology; Von Ahles, vegetable anatomy and physiology.

Würzburg: Virchow and Von Kölliker, histology; Von Sachs, vegetable anatomy and physiology; Semper, general zoology.

In these days of cramming for examinations it is pleasant to find a course of teaching carried on purely for the sake of imparting knowledge of any kind. The recently issued numbers of the "Journal of the Quekett Microscopical Club" contain, among the usual matter, reports of demonstrations given during the Session on subjects of importance to microscopists. This is not the first time that this Society has shown its anxiety to provide for the instruction of its younger members. Soon after its commencement, in 1865, arrangements were made for a course of lectures on the use of the microscope, and, thanks to the lecturer and his zealous demonstrators, the pupils acquired considerable knowledge of the manner of conducting histological investigations: so great was the success of this first attempt that in two succeeding years the lectures were repeated, and many of the pupils in the first course were able to render valuable service as assistants in the second and third. During the early part of the present Session the following demonstrations have been given by members who have made a special study of their respective subjects:—"Staining Tissues," one of the most recent and valuable aids to research. "Photo-micrography." "Shore Collecting," a subject upon which very little has been written, and where the experience of a collector accustomed to work on the sea-coast must prove of the greatest value to intending inquirers. "Preparing parts of Insects," a subject full of difficulties to the unassisted beginner. "Microscopic Vision," n which the much-neglected discoveries of Professor Abbe were simply and clearly explained. "Mosses," by a botanist who has

devoted his entire energies for many years to the subject. The whole course was, where practicable, fully illustrated, and every attention given to the answering of enquiries, which were very freely made.

Microscopists have not been slow in taking advantage of the introduction of the very sensitive dry plates. Several contrivances by which they can be utilised for the purposes of photo-micrography appear in the journals of the various societies. Most of the arrangements are simple in the extreme, and the light given by a well-constructed paraffin lamp is sufficient for obtaining good negatives with all but the highest powers.

Mr. J. Leiter, of Vienna, has constructed a singular modification of the microscope, to which the name of gastroscope has been given. Its use is for exploring the interior of the human stomach. It consists of a metal tube 65 c.m. long and 14 m.m. thick, bent at an angle of 150° at about one-fourth of its length from the lower end. At the lower extremity is contained an incandescent electric lamp for illumination of the interior of the stomach, and an objective at the back of which is a prism to reflect the pencil along the length of the tube; at the bend it is again reflected by another prism to the eye-piece. Provision is made for a circulation of cold water to prevent the lower end of the tube becoming inconveniently hot.

Dr. C. Virchow, in his Inaugural Dissertation, questions the prevalent opinion that the plants which formed upland peat-moors are capable of flourishing only on soils poor in lime.

"Biedermann's Central-Blatt" questions the opinion of Prof. W. N. Hartley, that the colouring-matter of peaty soils is analogous to alizarine.

Dr. T. M. Madden ("Medical Press") points out that, in the short time since the annual reports of the Commissioners in Lunacy have been issued, the proportion of insane persons has risen from 1 in 800 to 1 in 300 of the population. Mental derangement is now more common among women than among men, "one result of that hopeless contest with Nature's laws in which those are engaged who seek to unsex themselves by assuming all masculine pursuits and modes of life."

Cremation has been officially introduced in Brazil in the case of persons who die of yellow fever.

The "Medical Press and Circular" complains with just indignation of the inconsistency of the Legislature in sanctioning pigeon-shooting, whilst suppressing physiological experimentation.

M. V. Burq ("Comptes Rendus") strongly recommeds the internal and external use of copper as a preservative against the cholera.

According to M. B. Delachanal the bitumen of the Dead Sea is distinguished from other bitumens by the presence of sulphur in its composition.

Dr. Jackson, in a paper read before the West Kent Medico-Chirurgical Society, shows that pre-historical man was afflicted with a variety of diseases, including syphilis.

According to the "Medical Press and Circular" the wife of Prince Bismarck is "a trafficker in a nostrum, made from magpies' wings, for the cure of epilepsy"!

At the Glasgow Congress of the Sanitary Institute of Great Britain an address to the working classes was to be delivered by Dr. Alfred Carpenter, of Croydon,—doubtless in glorification of sewage-irrigation.

The Rev. A. Irving ("Geolog. Mag.") contends that the green colour of the Lower and Middle Bagshot Sands is due not to any mineral matter, but to vegetable impurities.

The recently-published observation that meat can be protected from putrefaction by means of carbonic acid was anticipated by Hermbstadt as early as 1791.

At the September meeting of the Entomological Society the Rev. Mr. Gorham read an interesting paper on the Insect Fauna of Japan, showing that it was not formed by immigration, but was essentially endemic.

At the same meeting was exhibited a hermaphrodite specimen of *Macropis labiata*.

Says Dr. H. Rowland, in the Physical Section of the American Association, "It is a fact in Nature which no democracy can change that men are *not* equal."

It appears that Dr. Hermann Kolbe, Professor at the University at Leipzig and Editor of the "Journal für Praktische Chemie," has been sentenced to a penalty of 200 marks for insulting Dr. Georg Krause, of Coethon, Editor of the "Chemiker Zeitung." In Germany it is exceedingly difficult to conduct a controversy without incurring the risk of legal proceedings; but by way of compensation the penalties and costs in such cases are out of all comparison smaller than in England.

Prof. G. Wiedemann, in a very brief notice of the experiments of the "Reichenbach Committee" of the Society for Psychical

Research, speaks of them as the "almost forgotten and already thoroughly refuted experiments of Reichenbach on the so-called Od."

Herr H. Dewitz ("Zoolog. Anzeiger") shows that in so-called apterous beetles (*e.g.*, *Niphus hololeucus*) rudimentary hind wings appear towards the close of the larval period, but become obsolete during the further development of the insect. Hence he concludes that this species once possessed fully developed wings which have gradually become abortive from disuse,—a change which must have modified other parts also.

M. H. Fol ("Comptes Rendus"), in a memoir on the "Origin of Individuality in the Higher Animals," comes to the conclusion that neither the ovum, nor the female nucleus, nor the spermatozooid, taken separately, suffices to determine the individuality.

Mr. J. D. Caton ("American Naturalist") gives an account of a cat which when she had caught a prairie gophir always brought it home to exhibit before devouring it. But when she had caught a bird, for which she had been often reproved, she always ate it in secret.

Mr. E. D. Cope, in the same journal, considers that the non-aggressive and over-harassed Herbivora have developed the higher brain-structure, whilst the inferiority of brain-type of the Carnivora is a well-known fact of present and past time.

It would appear that, as far as the number of members is concerned, the French Association for the Advancement of Science is more successful than the sister body on this side the Channel.

According to H. A. Wieler ("Botanische Zeitung") plants grow more rapidly in rarefied air than at the ordinary atmospheric pressure.

It is significant that official incapacity and corruption should reach their maximum in China, where competitive examinations have prevailed for so many centuries.

In the majority of plants the leaves, according to Haberlandt and Bœhm, exhale more strongly than the flowers.

Mexican meteorites, as compared with those of Europe, are distinguished by their greater magnitude.

Prof. Thomas Meehan finds that trees do not, as commonly supposed, expand on exposure to severe cold, from the freezing of the sap, but contract to a considerable extent.

Herr Munk ("Berlin. Akad. der Wissenschaft") finds that if

the cerebral hemispheres in birds are removed, total blindness ensues. If, *e.g.*, the right hemisphere is removed, the vision of the left eye is either entirely destroyed or greatly damaged, and if the right eye is then extirpated complete blindness results.

M. De Lapparent (" Les Mondes ") bases crystallography upon the following principle :—" In a homogeneous crystalline medium the physical properties, variable in general with the directions followed, are identical for all parallel directions, whatever may be the point of departure."

According to Dr. Arthur Christiani light exerts a favourable influence upon the vegetative sphere of the human economy, by increasing the activity of that portion of the brain upon which respiration depends.

M. Weber (" Chem. Central Blatt ") has found that the hydrocyanic acid secreted by myriapods of the genus *Fontaria* is elaborated by certain glands arranged along both sides of the animal. Does this secretion prove a protection against birds, spiders, &c. ?

Foods for infants now rank high among the positive checks to population.

The quack ought to be a patriot out of gratitude, for his country rears him a constant supply of dupes.

Mr. S. Kneeland gives, in " Science," a number of instances proving that crows do occasionally grasp and carry booty in their claws, after the manner of the Raptores.

M. Faye (" Comptes Rendus ") combats the theory of M. Delauney that the planets, especially Jupiter and Saturn, exert a decisive action upon earthquakes.

M. Ramon de Luna, in a communication to the Academy of Sciences, maintains that the cause of cholera is always found in the air, and that it acts upon men through the respiratory organs.

We regret to find that the Social Science Association is about to advocate increased restrictions on the sale of " poisons "—a step which will seriously hamper chemical research and harass various manufactures.

The assertion that a " high birth-rate is the invariable concomitant of prosperity " is refuted by the example of France.

According to Dr. Marloth (" Botanisches Jahrbücher ") almost all seeds are protected against injury from without by the development of thick, dense layers. The strata show such diversity

(even in closely allied groups) that their structure is of little value for systematic purposes.

Dr. Freire, of Rio Janeiro, shows that soil from the graves of persons who have died with yellow fever swarms with microbia, which by innoculation produce the disease in animals.

According to "Light" a Mrs. Croad, now of the Clapham Home for Incurables, though blind, is said to distinguish colours by passing the object over her cheek. To her "each colour has its peculiar degree of heat, smoothness, roughness, or projection. White is cold; black, hot or raised; red, very hot and smooth; blue, hot and grating; brown, very grating."

We are informed that on October 12th the Duke of Argyll will deliver a Lecture, in Glasgow, on "Geology and the Deluge."

We are happy to find that Mr. Gerald Massey's Lectures are being attended by large and intelligent audiences.

M. L. Crié ("Comptes Rendus") has made a study of the Eocene Flora of Western France, as compared with that of Alum Bay and Bournemouth.